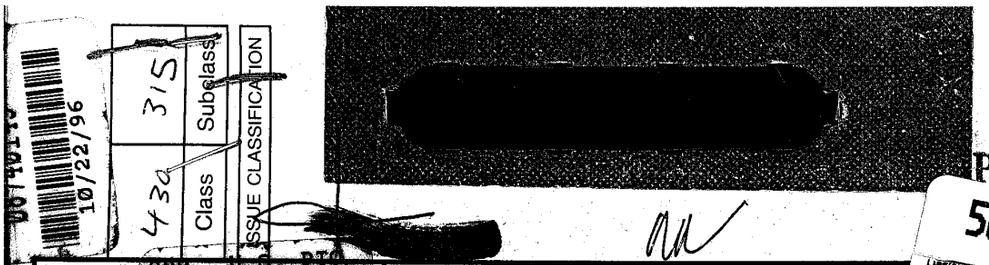

PILOT TEAM

UTILITY SERIAL NUMBER	PATENT DATE	PATENT NUMBER
08740145	JUL 29 1997	

SERIAL NUMBER	FILING DATE	CLASS	SUBCLASS	GROUP ART UNIT	EXAMINER
08/740,145	10/22/96	430	315	1113	DUDA

APPLICANTS

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA********
VERIFIED THIS APPLN IS A CON OF 08/361,595 12/22/94 ABN

ICAD

FOREIGN/PCT APPLICATIONS********
VERIFIED none

ICAD

FOREIGN FILING LICENSE GRANTED 11/18/96

Foreign priority claimed / 35 USC 119 conditions met / Verified and Acknowledged	AS FILED	STATE OR COUNTRY	SHEETS DRWGS.	TOTAL CLAIMS	INDEP. CLAIMS	FILING FEE RECEIVED	ATTORNEY'S DOCKET NO.
☐ yes ☑ no / ☐ yes ☑ no / ICAD (Examiner's initials)	→	CA	10	16	3	$770.00	16820.P048

ADDRESS

BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES CA 90025

TITLE

METHOD FOR REDUCED PITCH LITHOGRAPHY

U.S. DEPT. OF COMM./ PAT. & TM—PTO-436L (Rev.12-94)

PARTS OF APPLICATION FILED SEPARATELY

Applications Examiner

NOTICE OF ALLOWANCE MAILED	Assistant Examiner	CLAIMS ALLOWED: Total Claims	Print Claim
2-12-97		16.	1

ISSUE FEE: Amount Due	Date Paid	DRAWING: Sheets Drwg.	Figs. Drwg.	Print Fig.
1290.00	4-7-97	10	16	1

Kathleen Duda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100
Primary Examiner

ISSUE BATCH NUMBER J48

Label Area

PREPARED FOR ISSUE

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Form PTO-436A
(Rev. 8/92)

ISSUE FEE ON FILE

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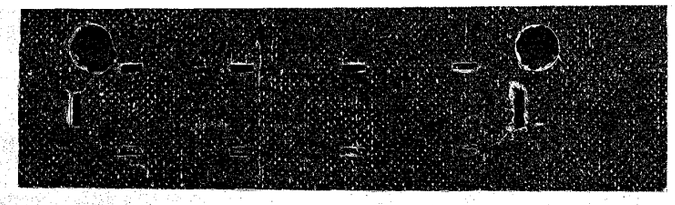
08/361595

Class | Subclass | ISSUE CLASSIFICATION



UTILITY SERIAL NUMBER	PATENT DATE	PATENT NUMBER
08/361595		

SERIAL NUMBER	FILING DATE	CLASS	SUBCLASS	GROUP ART UNIT	EXAMINER
08/361,595	12/22/94	430	311	1113	DUDA

APPLICANTS

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA********
VERIFIED none

ICMD

FOREIGN/PCT APPLICATIONS********
VERIFIED none

ICMD

FOREIGN FILING LICENSE GRANTED 03/30/95

Foreign priority claimed / 35 USC 119 conditions met	AS FILED	STATE OR COUNTRY	SHEETS DRWGS.	TOTAL CLAIMS	INDEP. CLAIMS	FILING FEE RECEIVED	ATTORNEY'S DOCKET NO.
☐ yes ☒ no / ☐ yes ☒ no		CA	10	22	2	$904.00	16820.P048
Verified and Acknowledged: Examiner's initials: ICMD							

ADDRESS

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

TITLE

METHOD FOR REDUCED PITCH LITHOGRAPHY

U.S. DEPT. of COMM.-Pat. & TM Office-PTO-436L (rev. 10-78)

PARTS OF APPLICATION FILED SEPARATELY		Applications Examiner
NOTICE OF ALLOWANCE MAILED	Assistant Examiner	CLAIMS ALLOWED: Total Claims / Print Claim
ISSUE FEE: Amount Due / Date Paid		DRAWING: Sheets Drwg. / Figs. Drwg. / Print Fig.
Label Area	Primary Examiner	ISSUE BATCH NUMBER
	PREPARED FOR ISSUE	

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Form PTO-436A
(Rev. 8/92)

(FACE)

08/361595

PATENT APPLICATION

08361595

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INITIALS JAN 179525

CONTENTS

Date Entered or Counted		Date Received or Mailed
	1. Application _____ papers.	
	2. LTR RE: SIGNATURE	3/01/95
	3. Decl, Surcharge	3/
(R) 5/01/95	4. Rejection (3 mos)	5/4/95
	5. Info. Disclosure Stmt	3/24/95
	6. Amdt A	8/4/95
10/01	7. Rej 3 mos.	10-27-95
	8. Ext (1)	03/04/96 2/27
	9. Amdt B	03/04/96 "
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	12. Ext (1)	9-30-96 COM 9-24-96
	13. Amdt "C" LN. ES (1)	9-30-96 COM 9-24-96
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	15. Ext. of time 2 mos.	10/22/96
12/16	16. Notice of Abandonment	12/18/96
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	17. pre amdt D	10/22/96
	18. pre amdt E	10/22/96
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CLASSIFIER		21	1/17/95
EXAMINER		319	1-30-95
TYPIST		343	3/30/95
VERIFIER		358	3-31
CORPS CORR.			
SPEC. HAND		412	3-28-95
FILE MAINT.		319	1-31-95
DRAFTING			

INDEX OF CLAIMS

Claim Final	Claim Original	Date 4/30/95	Date 12/26/95	Date 6/9/96
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SYMBOLS

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=	Allowed
-	(Through numberal) Canceled
+	Restricted
N	Non-elected
I	Interference
A	Appeal
O	Objected

Claim Final	Claim Original	Date
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EXAMINER	473 513	11/12/98
TYPIST		11-18
VERIFIER		
CORPS CORR.		
SPEC. HAND		
FILE MAINT.		
DRAFTING		

INDEX OF CLAIMS

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* U.S. GOVERNMENT PRINTING OFFICE: 1991-294-578

PATENT NUMBER

APPLICATION SERIAL NUMBER
08/740,145

APPLICANT'S NAME (PLEASE PRINT)
Cleeves

IF REISSUE, ORIGINAL PATENT NUMBER

INTERNATIONAL CLASSIFICATION 6

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ORIGINAL CLASSIFICATION

CLASS	SUBCLASS
430	315

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)			
430	313	328	330	

GROUP ART UNIT: 1113

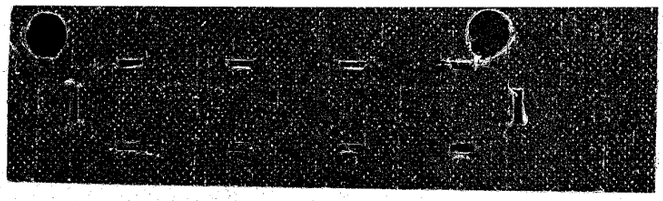
ASSISTANT EXAMINER (PLEASE STAMP OR PRINT FULL NAME)

PRIMARY EXAMINER (PLEASE STAMP OR PRINT FULL NAME)
Kathleen Duda

PTO 270
(REV. 5-91)

ISSUE CLASSIFICATION SLIP

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE



SEARCHED

Class	Sub.	Date	Exmr.
430	311, 313, 315, 324, 328, 330		
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	Updated search	6/9/96	KMD

related 510717

SEARCH NOTES

	Date	Exmr.
APS search encl	4/21/95	KMD
Updated APS search	10/25/95	KMD
Updated APS search	6/9/96	KMD

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.

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[redacted]

SEARCHED

Class	Sub.	Date	Exmr.
updated parent search		2/10/97	KHD
430	311, 313, 315, 324, 328, 330		

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
430	311, 313, 315, 324, 328, 330	2/10/97	KHD

SEARCH NOTES

	Date	Exmr.
APS search updated from parent	2/10/97	KHD

(RIGHT OUTSIDE)

4/19/95

PATENT APPLICATION SERIAL NO. 08/361595

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

040 SB 01/09/95 08361595 1 101 774.00 CK 16820.P048

PTO-1556
(5/87)

BAR CODE LABEL

U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/361,595	12/22/94	430	1506

APPLICANT

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA********
VERIFIED

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FOREIGN/PCT APPLICATIONS********
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FOREIGN FILING LICENSE GRANTED 03/30/95

STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS	FILING FEE RECEIVED	ATTORNEY DOCKET NO.
CA	10	22	2	$904.00	16820.P048

ADDRESS

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

TITLE

METHOD FOR REDUCED PITCH LITHOGRAPHY

This is to certify that annexed hereto is a true copy from the records of the United States Patent and Trademark Office of the application which is identified above.

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Date Certifying Officer

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U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/361,595	12/22/94	430	1113

APPLICANT

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA********
VERIFIED

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FOREIGN/PCT APPLICATIONS********
VERIFIED

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Date Certifying Officer

08/361595

Attorney's Docket No. 16820.P048 Patent

THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SIR: Transmitted herewith for filing is the patent application of

Inventor(s): James M. Cleeves

For: METHOD FOR REDUCED PITCH LITHOGRAPHY
(Title)

Enclosed are:

X 10 sheet(s) of Drawings.
_____ An Assignment of the invention to _____.
_____ Assignment Cover Sheet Form PTO-1595.
X A Declaration and Power of Attorney (_____ signed/ X unsigned).
_____ A Verified Statement to establish Small Entity Status under 37 C.F.R. §§ 1.9 and 1.27.
_____ _____.

The Filing Fee has been calculated as shown below:

	(Col. 1)		(Col. 2)	SMALL ENTITY		OTHER THAN A SMALL ENTITY	
For:	No. Filed		No. Extra	Rate	Fee	Rate	Fee
Basic Fee:					$ 365		$ 730
Total Claims:	22	- 20	* 2	x 11	$	x 22	$ 44
Indep. Claims:	2	- 3	* 0	x 38	$	x 76	$ 0
	Multiple Dependent Claim(s) Presented			**+120**	**$**	**+240**	**$**
				TOTAL	$	TOTAL	$ 774

* If the difference in Col. 1 is less than zero, enter "0" in Col. 2.

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Respectfully submitted,
BLAKELY, SOKOLOFF TAYLOR & ZAFMAN

Date: December 22, 1994

By _____
Matthew C. Fagan
Reg. No.: 37,542

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(408) 720-8598

(LJV/wes/cak 10/01/94)

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Christine A. Bybee
(Typed or printed name of person mailing paper or fee)

Christine A. Bybee
(Signature of person mailing paper or fee)

Attorney's Docket No. 16820.P048 Patent

THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SIR: Transmitted herewith for filing is the patent application of

Inventor(s): James M. Cleeves

For: METHOD FOR REDUCED PITCH LITHOGRAPHY
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For:	No. Filed		No. Extra	Rate	Fee	Rate	Fee
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Total Claims:	22	- 20	* 2	x 11	$	x 22	$ 44
Indep. Claims:	2	- 3	* 0	x 38	$	x 76	$ 0
	Multiple Dependent Claim(s) Presented			+120	$	+240	$
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Christine A. Bybee
(Typed or printed name of person mailing paper or fee)

Christine A. Bybee
(Signature of person mailing paper or fee)

UNITED STATES PATENT APPLICATION

for

METHOD FOR REDUCED PITCH LITHOGRAPHY

Inventor

James M. Cleeves

Prepared by:

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN
12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025-1026

(408) 720-8598

Attorney's Docket No. 16820.P048

"Express Mail" mailing label number: TB855647265US

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Christine A. Bybee
(Typed or printed name of person mailing paper or fee)

Christine A. Bybee
(Signature of person mailing paper or fee)

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774-101

08/361595

METHOD FOR REDUCED PITCH LITHOGRAPHY

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates generally to the field of semiconductor fabrication. More particularly, the present invention relates to the field of lithography processing for semiconductor fabrication.

2. Description of the Related Art:

Lithography processes are typically used for semiconductor fabrication, for example to form a mask over a layer to be patterned in accordance with various functional and/or design requirements for fabricating a desired semiconductor device.

For a typical lithography process, photoresist is deposited over the layer to be patterned and is exposed to ultraviolet radiation through a mask that defines the pattern to be formed in the photoresist. The photoresist is then developed to form a patterned photoresist layer over the underlying layer to be patterned. Those portions of the underlying layer that are not covered by photoresist may then be etched using suitable etch techniques and chemistries. The pattern in the photoresist is thus replicated in the underlying layer.

Typical lithography processes, however, limit the size and density with which semiconductor devices may be fabricated. For example, the minimum resolution capability of the lithography process determines the minimal pitch with which features for a patterned layer may be printed. The minimum lithographic resolution for a patterning process may depend, for example, on the lens used in exposing photoresist to radiation through the mask.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

One object of the present invention is to provide for a relatively reduced pitch for features of a patterned layer.

Another object of the present invention is to provide for the fabrication of relatively denser semiconductor devices.

Another object of the present invention is to provide for the fabrication of relatively smaller-sized semiconductor devices.

A lithography method for semiconductor fabrication using a semiconductor wafer is described. For the lithography method, a first imaging layer is formed over the semiconductor wafer. The first imaging layer is patterned in accordance with a first pattern to form a first patterned layer. The first patterned layer is stabilized. A second imaging layer is formed over the first patterned layer such that the first patterned layer is surrounded by the second imaging layer. The second imaging layer is patterned in accordance with a second pattern to form a second patterned layer.

Another lithography method for semiconductor fabrication using a semiconductor wafer is also described. For the lithography method, an imaging layer is formed over the semiconductor wafer. A portion of the imaging layer is exposed to radiation in accordance with a first pattern. The exposed portion of the imaging layer is stabilized. The imaging layer is patterned in accordance with a second pattern to form a patterned layer.

Other objects, features, and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description that follows below.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1 illustrates, in flow diagram form, one lithography method for semiconductor fabrication;

Figure 2 illustrates a cross-sectional view of a semiconductor wafer having a first imaging layer being exposed to radiation through a first mask;

Figure 3 illustrates a cross-sectional view of the semiconductor wafer of Figure 2 after the first imaging layer has been developed;

Figure 4 illustrates a cross-sectional view of the semiconductor wafer of Figure 3 where a second imaging layer is formed over the wafer and is being exposed to radiation through a second mask;

Figure 5 illustrates a cross-sectional view of the semiconductor wafer of Figure 4 after the second imaging layer has been developed;

Figure 6 illustrates, in flow diagram form, another lithography method for semiconductor fabrication;

Figure 7 illustrates a cross-sectional view of a semiconductor wafer having an imaging layer being exposed to radiation through a first mask;

Figure 8 illustrates a cross-sectional view of the semiconductor wafer of Figure 7 after an exposed portion of the imaging layer has been stabilized;

Figure 9 illustrates a cross-sectional view of the semiconductor wafer of Figure 8 where the imaging layer is exposed to radiation through a second mask;

Figure 10 illustrates a cross-sectional view of the semiconductor wafer of Figure 9 after an exposed portion of the imaging layer has been stabilized;

4

Figure 11 illustrates a cross-sectional view of the semiconductor wafer of Figure 10 after the imaging layer has been developed;

Figure 12 illustrates, in flow diagram form, another lithography method for semiconductor fabrication;

Figure 13 illustrates a cross-sectional view of a semiconductor wafer having an imaging layer being exposed to radiation through a first mask;

Figure 14 illustrates a cross-sectional view of the semiconductor wafer of Figure 13 after an exposed portion of the imaging layer has been stabilized;

Figure 15 illustrates a cross-sectional view of the semiconductor wafer of Figure 14 where the imaging layer is exposed to radiation through a second mask; and

Figure 16 illustrates a cross-sectional view of the semiconductor wafer of Figure 15 after the imaging layer has been developed.

DETAILED DESCRIPTION

The following detailed description sets forth an embodiment or embodiments in accordance with the present invention for method for reduced pitch lithography. In the following description, details are set forth such as specific materials, thicknesses, parameters, etc., in order to provide a thorough understanding of the present invention. It will be evident, however, that the present invention may be practiced without these details. In other instances, well-known process steps, equipment, etc., have not been described in particular detail so as not to obscure the present invention.

Figure 1 illustrates, in flow diagram form, one lithography method for semiconductor fabrication. For one embodiment, the method of Figure 1 may be used for semiconductor fabrication using a semiconductor wafer, such as the semiconductor wafer illustrated in Figures 2, 3, 4, and 5 for example.

For the method of Figure 1, a semiconductor substrate 200 is provided as illustrated in Figure 2. Substrate 200 may include any suitable semiconductor material, including silicon (Si) for example.

As illustrated in Figure 2, a layer 210 may be formed over substrate 200. Layer 210 may include any suitable material and may be formed to any suitable thickness using any suitable technique depending, for example, on the purpose of layer 210 in fabricating a desired semiconductor device. Layer 210 may include one or more layers, including device, dielectric, contact, interconnect, and/or via layers for example. Layer 210 is not necessary to practice the method of Figure 1.

As one example, layer 210 may include a layer that is to be patterned in accordance with a subsequent mask layer formed over layer 210. Layer 210 may include a dielectric layer, including silicon dioxide (SiO_2) for example, that is to be

patterned for a contact or interconnect layer, for example. Layer 210 may also include a layer over which a via or interconnect layer is to be formed. Layer 210 may have exposed regions to be electrically coupled by vias or interconnects formed in a subsequent layer.

For step 100 of Figure 1, a first imaging layer is formed over the semiconductor wafer. As illustrated in Figure 2, an imaging layer 220 is formed over layer 210. Imaging layer 220 may include any suitable material formed to any suitable thickness using any suitable technique.

For one embodiment, imaging layer 220 may include a suitable positive photoresist, for example, that has been spun-on to a thickness of approximately 10,000 Angstroms (Å). Other suitable thicknesses of positive photoresist, for example in the range of approximately 1,000 Å to approximately 30,000 Å, may also be used. For other embodiments, imaging layer 220 may include a suitable negative photoresist, a suitable radiation-sensitive polyimide, or other suitable radiation-sensitive materials for example. For this detailed description, the term radiation encompasses any energy radiated in the form of waves or particles. The term radiation may include ultraviolet (UV) light, x-ray radiation, electron beam or e-beam radiation, vacuum UV radiation, or ion beam radiation for example.

For step 110 of Figure 1, the first imaging layer is patterned in accordance with a first pattern to form a first patterned layer. Any suitable lithographic patterning technique may be used and may depend, for example, on the material used for imaging layer 220.

Where a positive-tone imaging material is used for imaging layer 220, such as a suitable positive photoresist or a suitable positive-tone radiation-sensitive polyimide for example, imaging layer 220 may be exposed to radiation through a

first mask having opaque feature 222 and clear features 221 and 223 as illustrated in Figure 2. The first mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 220. For this detailed description, the term mask encompasses a reticle, for example, for use in a step-and-repeat projection system.

Imaging layer 220 may be exposed through the first mask using any suitable form of radiation. The radiation serves to render soluble in a suitable developer that portion of imaging layer 220 exposed to radiation through clear features 221 and 223. That portion of imaging layer 220 that has not been exposed to radiation remains relatively insoluble in the developer.

Imaging layer 220 may then be developed in a suitable developer to form a first patterned layer 232. As illustrated in Figure 3, that portion of imaging layer 220 exposed to radiation through the first mask is soluble in the developer and is thus dissolved from imaging layer 220. That portion of imaging layer 220 that has not been exposed to radiation is relatively insoluble in the developer, and thus remains to form first patterned layer 232.

For other embodiments where a suitable negative-tone imaging material is used for imaging layer 220, the negative-tone imaging layer 220 may be exposed to any suitable form of radiation through a suitable negative-tone mask having opaque features 221 and 223 and a clear feature 222, for example. Negative-tone imaging materials may include a suitable negative photoresist, a suitable positive photoresist that is to be subjected to an image reversal process, or a suitable negative-tone radiation-sensitive polyimide for example. The negative-tone imaging layer 220 may be developed in a suitable developer to form a first patterned layer 232 as illustrated in Figure 3. That portion of imaging layer 220 exposed to radiation

through the first mask is relatively insoluble in the developer and thus remains to form first patterned layer 232. That portion of imaging layer 220 that has not been exposed to radiation is soluble in the developer and is thus dissolved from imaging layer 220.

For step 120 of Figure 1, the first patterned layer is stabilized. Any suitable stabilization technique may be used and may depend, for example, on the material used to form first patterned layer 232.

First patterned layer 232 may be stabilized to withstand subsequent lithographic processing steps. First patterned layer 232 may be stabilized to withstand chemical transformation as a result of any subsequent exposure to radiation, for example. First patterned layer 232 may also be stabilized to withstand dissolution by solvents during a subsequent spin-on of photoresist, for example. First patterned layer 232 may further be stabilized to withstand dissolution by a subsequent developer, for example.

Where a positive photoresist is used to form first patterned layer 232, a suitable deep ultraviolet (DUV) stabilization technique may be used to stabilize first patterned layer 232. For one embodiment, first patterned layer 232 may be irradiated with a DUV light source having a wavelength in the range of approximately 200 nanometers to approximately 400 nanometers, for example, and simultaneously heated with a temperature ramped up to approximately 230 degrees Celsius, for example, over an approximately 60 second period of time, for example. First patterned layer 232 may be irradiated at that peak temperature for approximately 5 seconds, for example. For other embodiments, first patterned layer 232 may be irradiated with a UV light source having other suitable wavelengths, for example in the range of approximately 100 nanometers to approximately 500 nanometers, and

9

may be heated to other suitable peak temperatures, for example in the range of approximately 120 degrees Celsius to approximately 250 degrees Celsius. First patterned layer 232 may be irradiated at a peak temperature for any suitable length of time, for example in the range of approximately 2 seconds to approximately 60 seconds.

Where first patterned layer 232 includes a positive photoresist, first patterned layer 232 may be stabilized using other suitable techniques. As one example, a prist technique may be used to form a carbon fluorine (CF_4) skin over first patterned layer 232 by exposing the photoresist to a fluorine ambient. A ~~silation~~ silylation technique may also be used to form a silicon dioxide (SiO_2) skin over first patterned layer 232. For other embodiments, other suitable techniques may be used to form a hardened skin over first patterned layer 232 to stabilize first patterned layer 232. For still other embodiments, the positive photoresist of first patterned layer 232 may be subjected to a suitable heat treatment or to a suitable radiation treatment to stabilize first patterned layer 232.

Stabilizing positive photoresist for first patterned layer 232 serves to neutralize photoactive compounds in the photoresist of first patterned layer 232. Upon any subsequent exposure to radiation then, first patterned layer 232 undergoes minimal, if any, chemical transformation. The photoresist of first patterned layer 232 may also be subjected to a subsequent spin-on of photoresist with relatively minimal, if any, dissolution by solvents of the subsequent photoresist layer. The photoresist of first patterned layer 232 may further be subjected to a subsequent development with relatively minimal, if any, dissolution by a developer.

For other embodiments where a negative photoresist is used to form first patterned layer 232, first patterned layer 232 may be stabilized while first patterned

layer 232 is being patterned. Because first patterned layer 232 is formed from that portion of negative photoresist that has been exposed to radiation and rendered relatively insoluble in a developer, the negative photoresist of first patterned layer 232 is able to withstand chemical transformation from any subsequent exposure to radiation and is able to withstand dissolution by a subsequent developer. The photoresist of first patterned layer 232, however, may be subjected to a suitable stabilization technique as necessary to withstand dissolution by solvents during a subsequent spin-on of photoresist, for example. A suitable DUV stabilization technique, a suitable prist technique, a suitable silylation technique, a suitable heat treatment, or a suitable radiation treatment, for example, may be used to stabilize the negative photoresist of first patterned layer 232.

For still other embodiments where a negative-tone radiation-sensitive polyimide is used to form first patterned layer 232, first patterned layer 232 may be stabilized while first patterned layer 232 is being patterned. Because first patterned layer 232 is formed from that portion of polyimide that has been exposed to radiation and rendered relatively insoluble in a developer, the polyimide of first patterned layer 232 is able to withstand chemical transformation from any subsequent exposure to radiation and is able to withstand dissolution by a subsequent developer. The polyimide of first patterned layer 232, however, may be subjected to a suitable stabilization technique, such as by heat treatment for final curing for example, as necessary to withstand dissolution by the formation of a subsequent layer over first patterned layer 232, for example.

For step 130 of Figure 1, a second imaging layer is formed over the semiconductor wafer. As illustrated in Figure 4, an imaging layer 240 is formed over first patterned layer 232 and over layer 210. Imaging layer 240 is formed to

surround first patterned layer 232 on the sidewalls of first patterned layer 232. Imaging layer 240 may optionally be formed to cover the top of first patterned layer 232 as well. Imaging layer 240 may include any suitable material formed to any suitable thickness using any suitable technique.

For one embodiment, imaging layer 240 may include a suitable positive photoresist, for example, that has been spun-on to a thickness of approximately 10,000 Å. Other suitable thicknesses of positive photoresist, for example thicknesses approximately equal to or greater than that of first patterned layer 232, may also be used. Imaging layer 240 may include other suitable materials, including a suitable negative photoresist, a suitable radiation-sensitive polyimide, or other suitable radiation-sensitive materials for example. For embodiments where photoresist is spun-on to form imaging layer 240, first patterned layer 232 has preferably been stabilized to withstand dissolution by solvents during spin-on of the photoresist for imaging layer 240.

For step 140 of Figure 1, the second imaging layer is patterned in accordance with a second pattern to form a second patterned layer. Any suitable lithographic patterning technique may be used and may depend, for example, on the material used for imaging layer 240.

Where a positive-tone imaging material is used for imaging layer 240, such as a suitable positive photoresist or a suitable positive-tone radiation-sensitive polyimide for example, imaging layer 240 may be exposed to radiation through a second mask having opaque features 242 and 244 and clear features 241, 243, and 245 as illustrated in Figure 4. The second mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 240.

Imaging layer 240 may be exposed through the second mask using any suitable form of radiation. The radiation serves to render soluble in a suitable developer that portion of imaging layer 240 exposed to radiation through clear features 241, 243, and 245. That portion of imaging layer 240 that has not been exposed to radiation remains relatively insoluble in the developer. As first patterned layer 232 has been stabilized, first patterned layer 232 undergoes minimal, if any, chemical transformation as a result of any exposure to radiation for patterning imaging layer 240.

Preferably, first patterned layer 232 does not affect in a material manner the lithographic patterning of imaging layer 240. That is, first patterned layer 232 preferably does not materially affect the desired patterning of imaging layer 240, for example, by reflecting any radiation. First patterned layer 232 may be treated using any suitable processing technique, such as bleaching or baking for example, as necessary to avoid or minimize adverse effects by first patterned layer 232 in patterning imaging layer 240. For one embodiment, the material used for first patterned layer 232 may match or substantially match the optical and mass properties, for example, of the material used for imaging layer 240 so as avoid or minimize any reflection of radiation in patterning imaging layer 240.

Imaging layer 240 may then be developed in a suitable developer to form a second patterned layer that includes features 251 and 253. As illustrated in Figure 5, that portion of imaging layer 240 exposed to radiation through the second mask is soluble in the developer and is thus dissolved from imaging layer 240. That portion of imaging layer 240 that has not been exposed to radiation is relatively insoluble in the developer, and thus remains to form features 251 and 253 for the second patterned layer. As first patterned layer 232 has been stabilized, first patterned layer

232 is relatively insoluble in developer and thus undergoes relatively minimal, if any, dissolution for the development of imaging layer 240.

For other embodiments where a suitable negative-tone imaging material is used for imaging layer 240, the negative-tone imaging layer 240 may be exposed to any suitable form of radiation through a suitable negative-tone mask having opaque features 241, 243, and 245 and clear features 242 and 244, for example. Negative-tone imaging materials may include a suitable negative photoresist, a suitable positive photoresist that is to be subjected to an image reversal process, or a suitable negative-tone radiation-sensitive polyimide for example. The negative-tone imaging layer 240 may be developed in a suitable developer to form features 251 and 253 for the second patterned layer as illustrated in Figure 5. That portion of imaging layer 240 exposed to radiation through the second mask is relatively insoluble in the developer and thus remains to form features 251 and 253. That portion of imaging layer 240 that has not been exposed to radiation is soluble in the developer and is thus dissolved from imaging layer 240.

For one embodiment for the method of Figure 1, a suitable positive photoresist may be used for both imaging layers 220 and 240 while a suitable deep ultraviolet (DUV) stabilization technique may be used to stabilize the positive photoresist for first patterned layer 232. For another embodiment, a suitable negative photoresist may be used for both imaging layers 220 and 240.

For a further embodiment for the method of Figure 1, imaging layer 220 may include a suitable positive photoresist and may be exposed through a suitable negative-tone mask. Imaging layer 220 may then be subjected to a suitable image reversal process to form first patterned layer 232. The image reversal process preferably serves to stabilize first patterned layer 232. The photoresist of first

patterned layer 232, however, may be subjected to a suitable stabilization technique, such as a suitable DUV stabilization technique for example, as necessary to withstand dissolution by solvents during a subsequent spin-on of photoresist. Imaging layer 240 for this embodiment may include any suitable material and may be patterned using any suitable lithographic patterning technique to form the second patterned layer.

As a result of the method of Figure 1, a single patterned layer is formed over layer 210 as illustrated in Figure 5. This single patterned layer is formed from the patterning of imaging layer 220 and the subsequent patterning of imaging layer 240.

Figure 6 illustrates, in flow diagram form, another lithography method for semiconductor fabrication. For one embodiment, the method of Figure 6 may be used for semiconductor fabrication using a semiconductor wafer, such as the semiconductor wafer illustrated in Figures 7, 8, 9, 10, and 11 for example.

For the method of a Figure 6, a semiconductor substrate 400 is provided as illustrated in Figure 7. Substrate 400 may include any suitable semiconductor material, including silicon (Si) for example.

As illustrated in Figure 7, a layer 410 may be formed over substrate 400. Layer 410 may include any suitable material and may be formed to any suitable thickness using any suitable technique depending, for example, on the purpose of layer 410 in fabricating a desired semiconductor device. The above discussion pertaining to layer 210 for the method of Figure 1 also pertains to layer 410 for the method of Figure 6.

For step 300 of Figure 6, an imaging layer is formed over the semiconductor wafer. As illustrated in Figure 7, an imaging layer 420 is formed over layer 410. Imaging layer 420 may include any suitable material formed to any suitable thickness using any suitable technique.

For one embodiment, imaging layer 420 may include a suitable positive photoresist, for example, that has been spun-on to a thickness of approximately 10,000 Å. Other suitable thicknesses of positive photoresist, for example in the range of approximately 1,000 Å to approximately 30,000 Å, may also be used. For other embodiments, imaging layer 420 may include other suitable radiation-sensitive materials.

For step 310 of Figure 6, the imaging layer is exposed to radiation in accordance with a first pattern. Imaging layer 420 may be exposed in accordance with any suitable pattern using any suitable form of radiation.

Imaging layer 420 may be exposed to radiation through a first mask having opaque features 421 and 423 and clear feature 422 as illustrated in Figure 7. The first mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 420. Where a positive photoresist is used for imaging layer 420 and is to be subjected to an image reversal process, the first mask may be a suitable negative-tone mask to form the desired pattern in imaging layer 420.

For step 320 of Figure 6, that portion of the imaging layer exposed to radiation is stabilized. Any suitable stabilization technique may be used and may depend, for example, on the material used to form imaging layer 420. As illustrated in Figure 8, an exposed portion 432 of imaging layer 420 has been stabilized.

Exposed portion 432 of imaging layer 420 may be stabilized to withstand subsequent lithographic processing steps. Exposed portion 432 may be stabilized to withstand chemical transformation as a result of any subsequent exposure to radiation, for example. Exposed portion 432 may also be stabilized to withstand dissolution by a subsequent developer, for example.

Where a suitable positive photoresist is used to form imaging layer 420, a suitable image reversal process may be used to stabilize exposed portion 432 of imaging layer 420. For one embodiment, imaging layer 420 may be, after the exposure to radiation through the first mask, subjected to an ammonia (NH_3) ambient and heated to a temperature of approximately 95 degrees Celsius, for example, in an approximately 600 torr environment, for example, for approximately 45 minutes, for example. Other suitable temperatures, pressures, and periods of time may also be used. Temperatures may range from approximately 80 degrees Celsius to approximately 110 degrees Celsius, for example. Pressures may range from approximately 500 torr to approximately 760 torr, for example. Time periods may range from approximately 30 minutes to approximately 60 minutes, for example.

For other embodiments, a suitable positive photoresist may be used for imaging layer 420 such that heating imaging layer 420 invokes the image reversal process to stabilize exposed portion 432.

Stabilizing positive photoresist in exposed portion 432 serves to neutralize photoactive compounds in exposed portion 432. Upon any exposure to radiation then, exposed portion 432 undergoes minimal, if any, chemical transformation. Exposed portion 432 may also be subjected to a subsequent development with relatively minimal, if any, dissolution by a developer.

For step 330 of Figure 6, the imaging layer is exposed to radiation in accordance with a second pattern. Imaging layer 420 may be exposed in accordance with any suitable pattern using any suitable form of radiation.

Imaging layer 420 may be exposed to radiation through a second mask having opaque features 441, 443, and 445 and clear features 442 and 444 as illustrated in

Figure 9. The second mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 420. Where a positive photoresist is used for imaging layer 420 and is to be subjected to an image reversal process, the second mask may be a suitable negative-tone mask to form the desired pattern in imaging layer 420.

For step 340 of Figure 6, that portion of the imaging layer exposed to radiation for step 330 is stabilized. Any suitable stabilization technique may be used and may depend, for example, on the material used to form imaging layer 420. As illustrated in Figure 10, an exposed portion 431 and 433 of imaging layer 420 has been stabilized.

Exposed portion 431 and 433 of imaging layer 420 may be stabilized to withstand subsequent lithographic processing steps. Exposed portion 431 and 433 may be stabilized to withstand chemical transformation as a result of any subsequent exposure to radiation, for example. Exposed portion 431 and 433 may also be stabilized to withstand dissolution by a subsequent developer, for example.

Where a suitable positive photoresist is used to form imaging layer 420, a suitable image reversal process may be used to stabilize exposed portion 431 and 433 of imaging layer 420. For one embodiment, imaging layer 420 may be subjected to an image reversal process similar to the image reversal process used to stabilize exposed portion 432. The above discussion regarding the image reversal process for exposed portion 432 similarly applies for stabilizing exposed portion 431 and 433.

Stabilizing the positive photoresist in exposed portion 431 and 433 serves to neutralize photoactive compounds in exposed portion 431 and 433. Upon any exposure to radiation then, exposed portion 431 and 433 undergoes minimal, if any, chemical transformation. Exposed portion 431 and 433 may also be subjected to a

subsequent development with relatively minimal, if any, dissolution by a developer.

Where positive photoresist has been subjected to an image reversal process to render exposed portions 431, 432, and 433 relatively insoluble, imaging layer 420 may be subjected to a flood exposure of radiation to render the remaining portion of imaging layer 420 soluble for development. This remaining portion of imaging layer 420 has not been previously exposed to radiation through the first or second masks. Imaging layer 420 may be flood exposed using any suitable form of radiation. For one embodiment, the positive photoresist of imaging layer 420 may be subjected to approximately 600 millijoules of a collimated light beam approximately 365 nanometers in wavelength for this flood exposure. As portions 431, 432, and 433 of imaging layer 420 have been stabilized, portions 431, 432, and 433 undergo minimal, if any, chemical transformation as a result of any exposure to radiation for patterning imaging layer 420.

For step 350 of Figure 6, the imaging layer is developed to form a patterned layer. Imaging layer 420 may be developed in any suitable developer to form a patterned layer that includes portions 431, 432, and 433 as illustrated in Figure 11. As portions 431, 432, and 433 of imaging layer 420 have been stabilized, portions 431, 432, and 433 are relatively insoluble in developer and thus undergo relatively minimal, if any, dissolution. Portions 431, 432, and 433 thus remain to form features 431, 432, and 433 for the patterned layer after development. The remaining portion of imaging layer 420 is dissolved from imaging layer 420 in the developer.

As a result of the method of Figure 6, a single patterned layer is formed over layer 410 as illustrated in Figure 11.

For another embodiment for the method of Figure 6, a suitable negative-tone radiation-sensitive polyimide may be used to form imaging layer 420 for step 300 of Figure 6. For step 310 of Figure 6, imaging layer 420 may be exposed to radiation through a first suitable negative-tone mask as illustrated in Figure 7. The exposure of the polyimide to radiation for step 310 of Figure 6 serves to stabilize exposed portion 432 for step 320 of Figure 6, as illustrated in Figure 8. Upon any subsequent exposure to radiation, exposed portion 432 undergoes minimal, if any, chemical transformation. Exposed portion 432 may also be subjected to a subsequent development with relatively minimal, if any, dissolution by a developer.

For step 330 of Figure 6, imaging layer 420 may be exposed to radiation through a second suitable negative-tone mask, as illustrated in Figure 9. The exposure of the polyimide to radiation for step 330 of Figure 6 serves to stabilize exposed portion 431 and 433 for step 340 of Figure 6, as illustrated in Figure 10. Exposed portion 431 and 433 may be subjected to a subsequent development with relatively minimal, if any, dissolution by a developer.

For step 350 of Figure 6, the polyimide of imaging layer 420 may be developed in any suitable developer to form a patterned layer that includes portions 431, 432, and 433 as illustrated in Figure 11. The resulting single patterned layer may then be finally cured using a suitable heat treatment.

Figure 12 illustrates, in flow diagram form, another lithography method for semiconductor fabrication. For one embodiment, the method of Figure 12 may be used for semiconductor fabrication using a semiconductor wafer, such as the semiconductor wafer illustrated in Figures 13, 14, 15, and 16 for example.

For the method of a Figure 12, a semiconductor substrate 600 is provided as illustrated in Figure 13. Substrate 600 may include any suitable semiconductor material, including silicon (Si) for example.

As illustrated in Figure 13, a layer 610 may be formed over substrate 600. Layer 610 may include any suitable material and may be formed to any suitable thickness using any suitable technique depending, for example, on the purpose of layer 610 in fabricating a desired semiconductor device. The above discussion pertaining to layer 210 for the method of Figure 1 also pertains to layer 610 for the method of Figure 12.

For step 500 of Figure 12, an imaging layer is formed over the semiconductor wafer. As illustrated in Figure 13, an imaging layer 620 is formed over layer 610. Imaging layer 620 may include any suitable material formed to any suitable thickness using any suitable technique.

For one embodiment, imaging layer 620 may include a suitable positive photoresist, for example, that has been spun-on to a thickness of approximately 10,000 Å. Other suitable thicknesses of positive photoresist, for example in the range of approximately 1,000 Å to approximately 30,000 Å, may also be used.

For step 510 of Figure 12, the imaging layer is exposed to radiation in accordance with a first pattern. Imaging layer 620 may be exposed in accordance with any suitable pattern using any suitable form of radiation.

Where a positive photoresist is used for imaging layer 620, imaging layer 620 may be exposed to radiation through a first mask having opaque features 621 and 623 and clear feature 622 as illustrated in Figure 13. The first mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 620. Where a positive photoresist is

used for imaging layer 620 and is to be subjected to an image reversal process, the first mask may be a suitable negative-tone mask to form the desired pattern in imaging layer 620.

For step 520 of Figure 12, that portion of the imaging layer exposed to radiation is stabilized. Any suitable stabilization technique may be used and may depend, for example, on the material used to form imaging layer 620. As illustrated in Figure 14, an exposed portion 632 of imaging layer 620 has been stabilized.

Exposed portion 632 of imaging layer 620 may be stabilized to withstand subsequent lithographic processing steps. Exposed portion 632 may be stabilized to withstand chemical transformation as a result of any subsequent exposure to radiation, for example. Exposed portion 632 may also be stabilized to withstand dissolution by a subsequent developer, for example.

Where a suitable positive photoresist is used to form imaging layer 620, a suitable image reversal process may be used to stabilize exposed portion 632 of imaging layer 620. For one embodiment, imaging layer 620 may be, after the exposure to radiation through the first mask, subjected to an ammonia (NH_3) ambient and heated to a temperature of approximately 95 degrees Celsius, for example, in an approximately 600 torr environment, for example, for approximately 45 minutes, for example. Other suitable temperatures, pressures, and periods of time may also be used. Temperatures may range from approximately 80 degrees Celsius to approximately 110 degrees Celsius, for example. Pressures may range from approximately 500 torr to approximately 760 torr, for example. Time periods may range from approximately 30 minutes to approximately 60 minutes, for example.

For other embodiments, a suitable positive photoresist may be used for imaging layer 620 such that heating imaging layer 620 invokes the image reversal process to stabilize exposed portion 632.

Stabilizing positive photoresist in exposed portion 632 serves to neutralize photoactive compounds in exposed portion 632. Upon any exposure to radiation then, exposed portion 632 undergoes minimal, if any, chemical transformation. Exposed portion 632 may also be subjected to a subsequent development with relatively minimal, if any, dissolution by a developer.

For step 530 of Figure 12, the imaging layer is exposed to radiation in accordance with a second pattern. Imaging layer 620 may be exposed in accordance with any suitable pattern using any suitable form of radiation.

Where a positive photoresist is used for imaging layer 620, imaging layer 620 may be exposed to radiation through a second mask having opaque features 642 and 644 and clear features 641, 643, and 645 as illustrated in Figure 15. The second mask may include any suitable pattern of opaque and clear features that may depend, for example, on the desired pattern to be formed in imaging layer 620.

Imaging layer 620 may be exposed through the second mask using any suitable form of radiation. The radiation serves to render soluble in a suitable developer that portion of imaging layer 620 exposed to radiation through clear features 641, 643, and 645. As portion 632 of imaging layer 620 has been stabilized, portion 632 undergoes minimal, if any, chemical transformation as a result of any exposure to radiation for patterning imaging layer 620. Portion 632 thus remains relatively insoluble despite any exposure to radiation. That portion of imaging layer 620 that has not been exposed to radiation remains relatively insoluble in the developer.

Preferably, portion 632 of imaging layer 620 does not affect in a material manner the subsequent lithographic patterning of imaging layer 620. That is, portion 632 preferably does not materially affect the desired subsequent patterning of imaging layer 620, for example, by reflecting any radiation.

For step 540 of Figure 12, the imaging layer is developed to form a patterned layer. Imaging layer 620 may be developed in any suitable developer to form a patterned layer that includes features 631, 632, and 633 as illustrated in Figure 16. That portion of imaging layer 620 exposed to radiation through the second mask is soluble in the developer and is thus dissolved from imaging layer 620. As portion 632 of imaging layer 620 has been stabilized, portion 632 is relatively insoluble in developer and thus undergoes relatively minimal, if any, dissolution for the development of imaging layer 620. That portion of imaging layer 620 that has not been exposed to radiation is also relatively insoluble in the developer, and thus remains to form features 631 and 633 for the patterned layer.

As a result of the method of Figure 12, a single patterned layer is formed over layer 610 as illustrated in Figure 16.

Although the methods of Figures 1, 6, and 12 are illustrated as using masks for the selective exposure of imaging layers to radiation, other suitable lithographic techniques may also be used for the methods of Figures 1, 6, and 12 to expose imaging layers to radiation in accordance with suitable patterns. As one example, a suitable direct-write exposure technique may be used to expose an imaging layer to radiation in accordance with a suitable pattern.

For the methods of Figures 1, 6, and 12, features for the resulting single patterned layer, such as the patterned layer illustrated in Figures 5, 11, and 16 respectively, may be formed relatively closer to one another as the resolution of the

lens for the lithographic patterning of an imaging layer through a single exposure to radiation does not limit the pitch for adjacent features of the single patterned layer. As these features may be formed relatively closer to one another, the density with which semiconductor devices may be fabricated may be increased, allowing semiconductor devices to be fabricated with relatively smaller sizes.

The lithography methods of Figure 1, 6, and 12 may be used, for example, in fabricating various semiconductor devices, including digital components such as microprocessors, memories such as random access memories (RAMs), controllers, etc.

The lithography methods of Figures 1, 6, and 12 may be used, for example, to form a single patterned layer that serves as a mask in patterning an underlying layer, such as layers 210, 410, and 610 respectively. The underlying layer may be patterned using a suitable etch technique and chemistry. As the pattern in the mask layer, such as the single patterned layer illustrated in Figures 5, 11, and 16, becomes replicated in the underlying layer, features for the underlying layer may be formed relatively closer to one another.

As another example, the lithography methods of Figures 1, 6, and 12 may be used to form disposable posts as discussed in U.S. Application Serial No. 08/179,615, filed January 10, 1994, entitled DISPOSABLE POST PROCESSING FOR SEMICONDUCTOR DEVICE FABRICATION, by James M. Cleeves, and assigned to the same assignee as the present application. As disposable posts are removed to form openings for a subsequent layer, such as a contact, via, or interconnect layer for example, such openings may be formed relatively closer to one another.

In the foregoing description, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that

various modifications and changes may be made thereto without departing from the broader spirit or scope of the present invention as defined in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

1. A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer such that the first patterned layer is surrounded by the second imaging layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer.

2. The method of claim 1, wherein the first imaging layer includes a positive photoresist.

3. The method of claim 1, wherein the second imaging layer includes a positive photoresist.

4. The method of claim 1, wherein the patterning step (b) includes the steps of:

(i) exposing a portion of the first imaging layer to radiation in accordance with the first pattern, and

(ii) developing the first imaging layer such that the exposed portion dissolves to form the first patterned layer.

5. The method of claim 1, wherein the patterning step (e) includes the steps of:

(i) exposing a portion of the second imaging layer to radiation in accordance with the second pattern, and

(ii) developing the second imaging layer such that the exposed portion dissolves to form the second patterned layer.

6. The method of claim 1, wherein the patterning step (b) includes the step of exposing a portion of the first imaging layer to radiation through a mask.

7. The method of claim 1, wherein the patterning step (e) includes the step of exposing a portion of the second imaging layer to radiation through a mask.

8. The method of claim 1, wherein the stabilizing step (c) includes the step of using a prist technique to stabilize the first patterned layer.

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9. The method of claim 1, wherein the stabilizing step (c) includes the step of using a silation technique to stabilize the first patterned layer.

10. The method of claim 1, wherein the stabilizing step (c) includes the steps of:

(i) exposing the first patterned layer to radiation, and

(ii) heating the first patterned layer.

11. The method of claim 10, wherein the exposing step (c)(i) includes the step of exposing the first patterned layer to radiation having a wavelength in a range from approximately 200 nanometers to approximately 400 nanometers; and

wherein the heating step (c)(ii) includes the step of heating the first patterned layer at a temperature ramped to approximately 230 degrees Celsius.

12. A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming an imaging layer over the semiconductor wafer;

(b) exposing a portion of the imaging layer to radiation in accordance with a first pattern;

(c) stabilizing the exposed portion of the imaging layer; and

(d) patterning the imaging layer in accordance with a second pattern to form a patterned layer.

13. The method of claim 12, wherein the imaging layer includes a positive photoresist.

14. The method of claim 12, wherein the patterning step (d) includes the steps of:

(i) exposing the imaging layer to radiation in accordance with the second pattern, and

(ii) developing the imaging layer to form the patterned layer.

15. The method of claim 12, wherein the exposing step (b) includes the step of exposing the portion of the imaging layer to radiation through a mask.

16. The method of claim 12, wherein the patterning step (d) includes the step of exposing a portion of the imaging layer to radiation through a mask.

17. The method of claim 12, wherein the stabilizing step (c) includes the step of subjecting the imaging layer to an image reversal process.

18. The method of claim 17, wherein the subjecting step includes the steps of:

(i) subjecting the imaging layer to an ammonia ambient, and

(ii) heating the imaging layer.

19. The method of claim 18, wherein the heating step includes the step of heating the imaging layer to a temperature in a range of approximately 80 degrees Celsius to approximately 110 degrees Celsius.

20. The method of claim 12, wherein the patterning step (d) includes the steps of:

(i) exposing another portion of the imaging layer to radiation in accordance with the second pattern,

(ii) stabilizing the exposed other portion of the imaging layer,

(iii) exposing the imaging layer to radiation, and

(iv) developing the imaging layer to form the patterned layer.

21. The method of claim 20, wherein the stabilizing step (d)(ii) includes the step of subjecting the imaging layer to an image reversal process.

22. The method of claim 21, wherein the subjecting step includes the steps of:

(i) subjecting the imaging layer to an ammonia ambient, and

(ii) heating the imaging layer.

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ABSTRACT OF THE DISCLOSURE

A lithographic patterning process uses multiple exposures to provide for relatively reduced pitch for features of a single patterned layer. A first imaging layer is exposed to radiation in accordance with a first pattern and developed. The resulting patterned layer is stabilized. A second imaging layer is subsequently formed to surround the first patterned layer, exposed to radiation in accordance with a second pattern, and developed to form a second patterned layer. As the first patterned layer has been stabilized, the first patterned layer remains with the second patterned layer to produce a single patterned layer. For another embodiment, a single imaging layer is patterned by exposure to radiation in accordance with two separate patterns. An exposed portion of the imaging layer is suitably stabilized to withstand subsequent lithographic process steps.

Attorney's Docket No.: 16820.P048 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD FOR REDUCED PITCH LITHOGRAPHY

the specification of which

___X___ is attached hereto.
_____ was filed on _____ as
Application Serial No. _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	Filing Date	(Status -- patented, pending, abandoned)
(Application Serial No.)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint Keith G. Askoff, Reg. No. 33,828; Aloysius T. C. AuYeung, Reg. No. 35,432; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Timothy R. Croll, Reg. No. 36,771; Daniel M. De Vos, Reg. 37,813; Matthew C. Fagan, Reg. No. 37,542; Scot A. Griffin, Reg. No. 38,167; Stephen D. Gross, Reg. No. 31,020; David R. Halvorson, Reg. No. 33,395; Michael D. Hartogs, Reg. No. 36,547; Brian Don Hickman, Reg. No. 35,894; George W Hoover II, Reg. No. 32,992; Paul H. Horstmann, Reg. No. 36,167; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg No. 36,172; Stephen L. King, Reg. No. 19,180; Joseph T. Lin, Reg. No. 38,225; Michael J. Mallie, Reg. No. 36,591; James D. McFarland, Reg. No. 32,544; Anthony C. Murabito, Reg. No. 35,295; Kimberley G. Nobles, Reg. No. 38,255; Ronald W. Reagin, Reg. No. 20,340; James H. Salter, Reg. No. 35,668; Robert A. Saltzberg, Reg. No. 36,910; James C. Scheller, Reg. No. 31,195; Edward W. Scott, IV, Reg. No. 36,000; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; John C. Stattler, Reg. No. 36,285; Edwin H. Taylor, Reg. No. 25,129; Lester J. Vincent, Reg. No. 31,460; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and William Donald Davis, Reg. No. 38,428; Thomas X. Li, Reg. No. 37,079; and Edwin A. Sloane, Reg. No. 34,728; my patent agents; of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor James M. Cleeves

Inventor's Signature _____ Date _____

Residence Redwood City, California (City, State) Citizenship United States of America (Country)

Post Office Address 551 Summit Drive
Redwood City, California 94062

Full Name of Second/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ (City, State) Citizenship _____ (Country)

Post Office Address _____

Full Name of Third/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ (City, State) Citizenship _____ (Country)

Post Office Address _____

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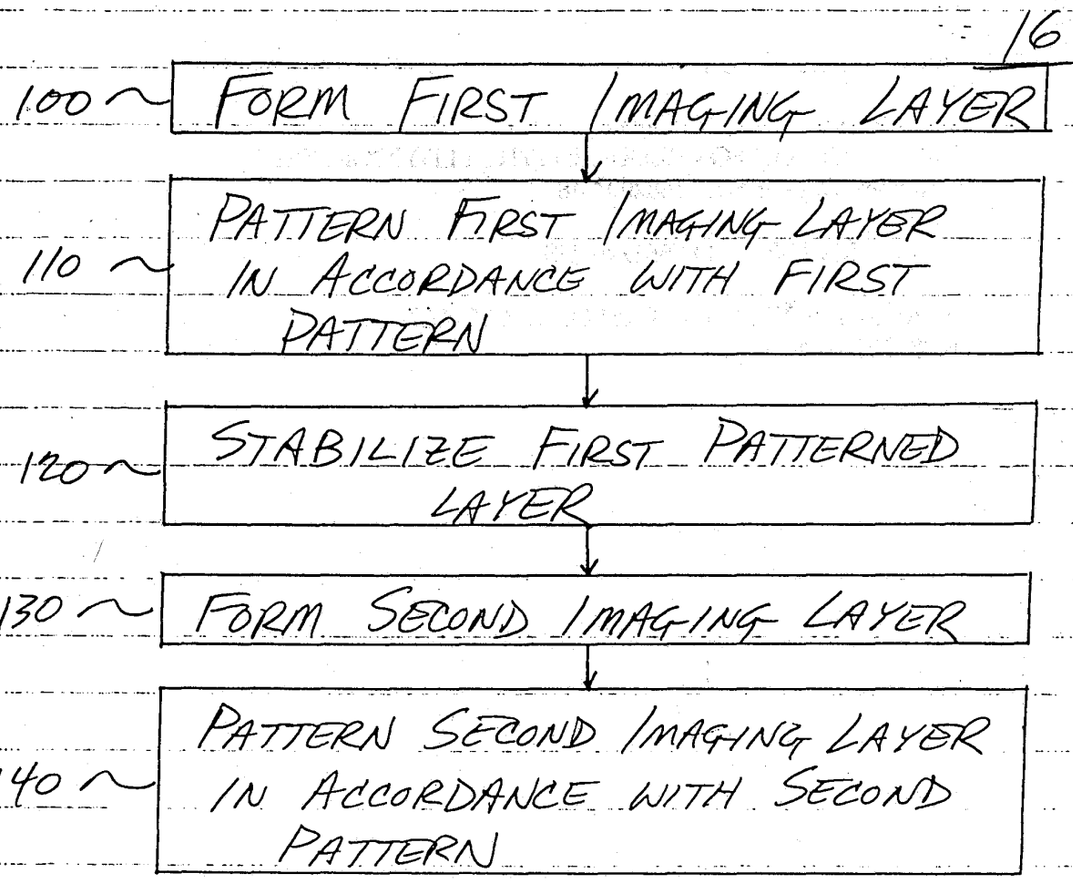

FIG. 1

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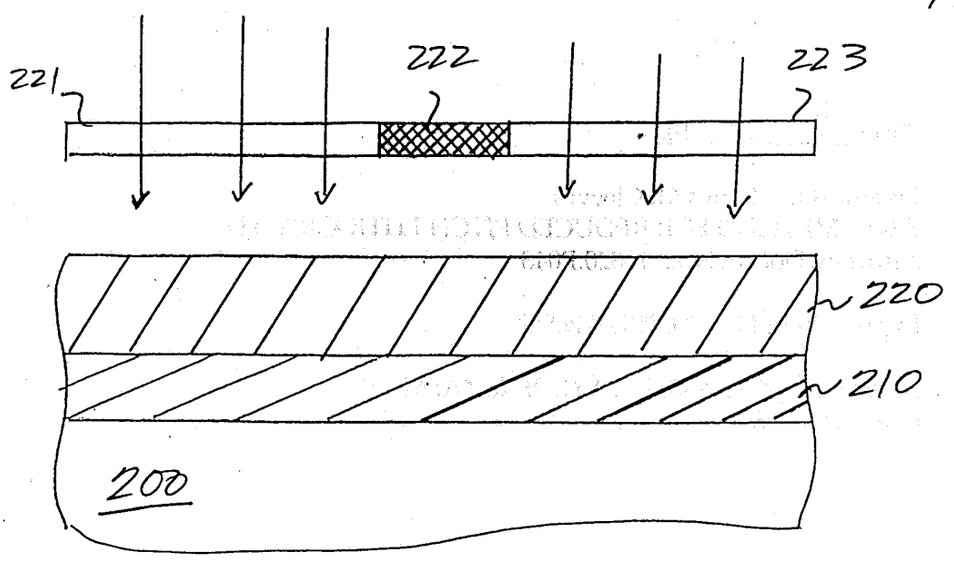

FIG. 2

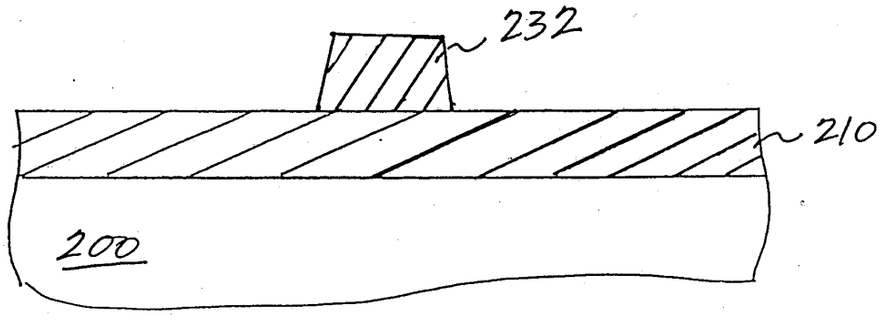

FIG. 3

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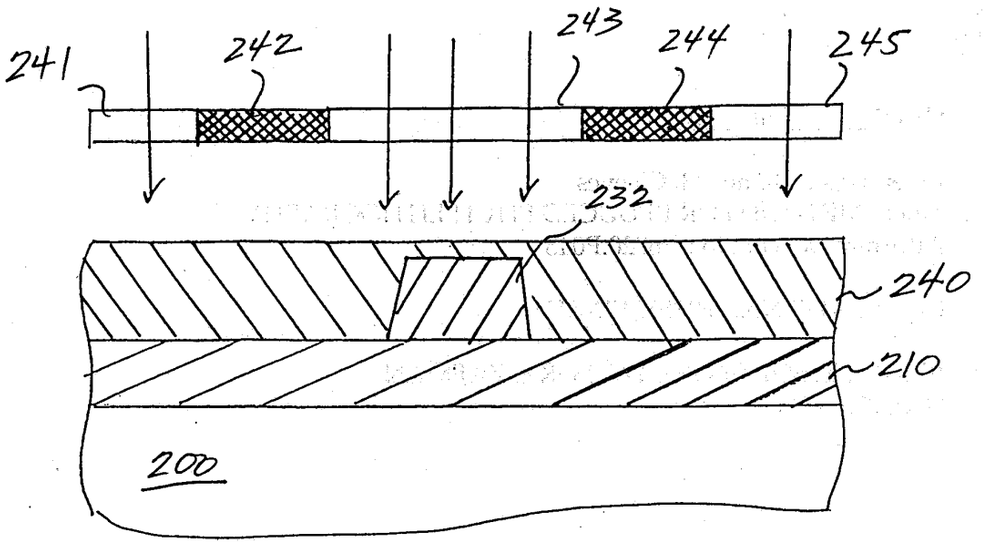

FIG. 4

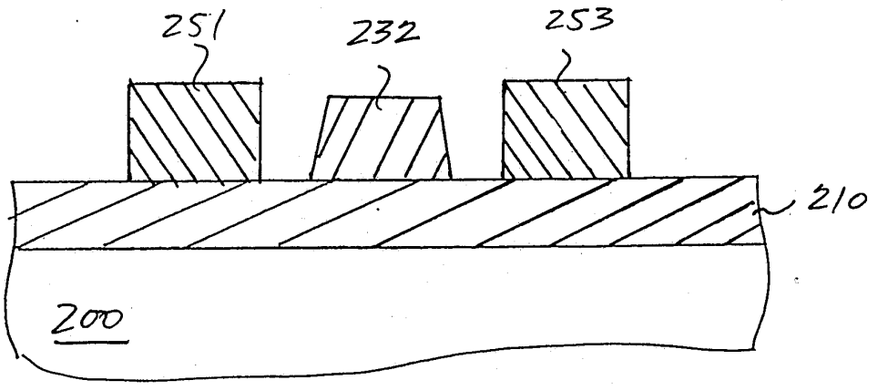

FIG. 5

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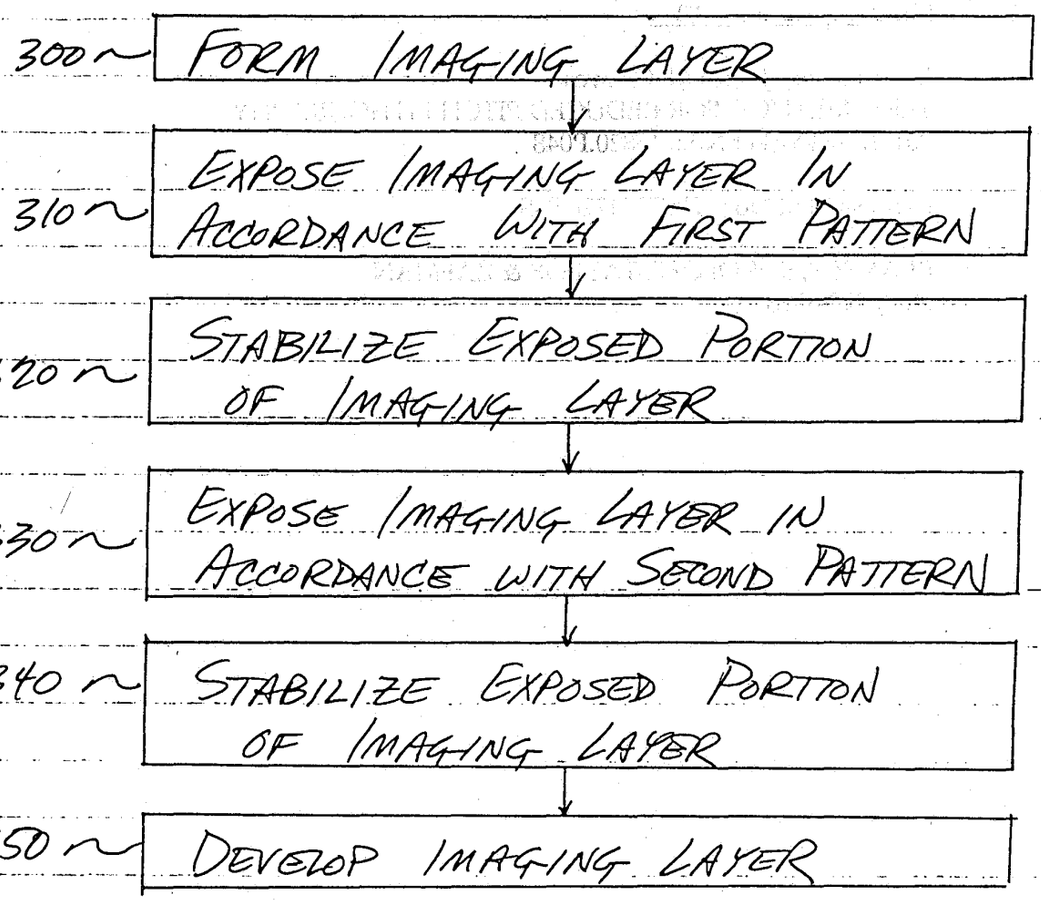

FIG. 6

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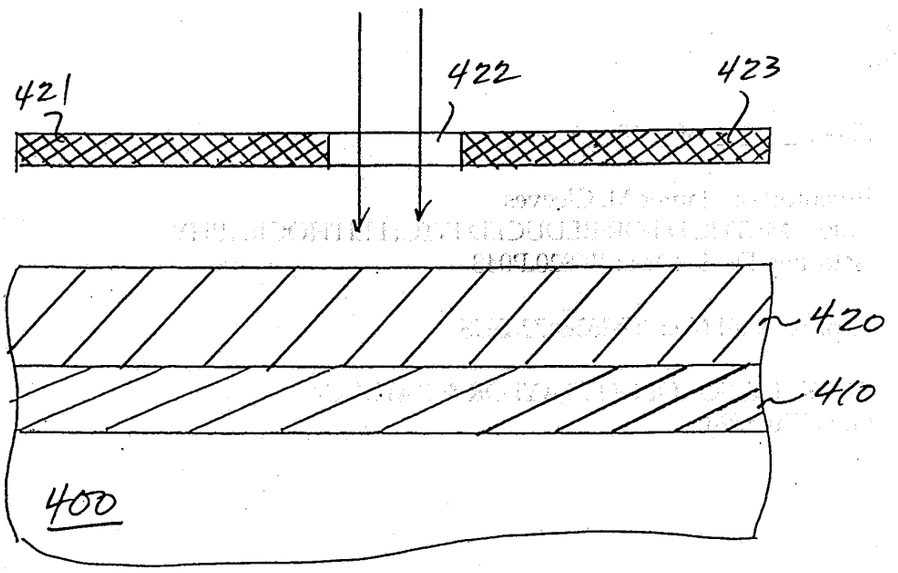

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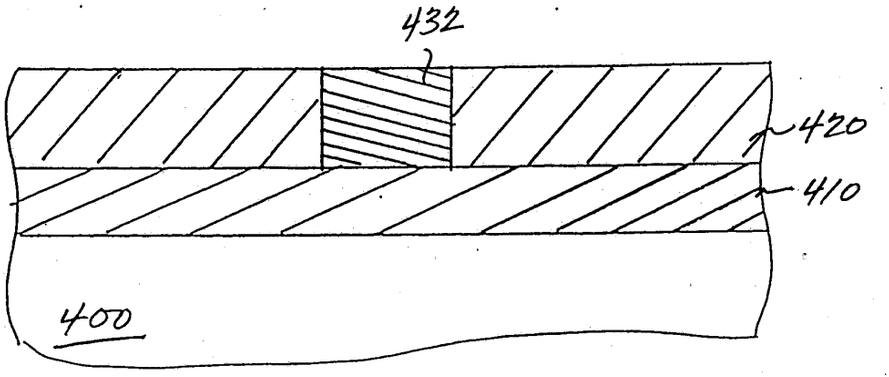

FIG. 8

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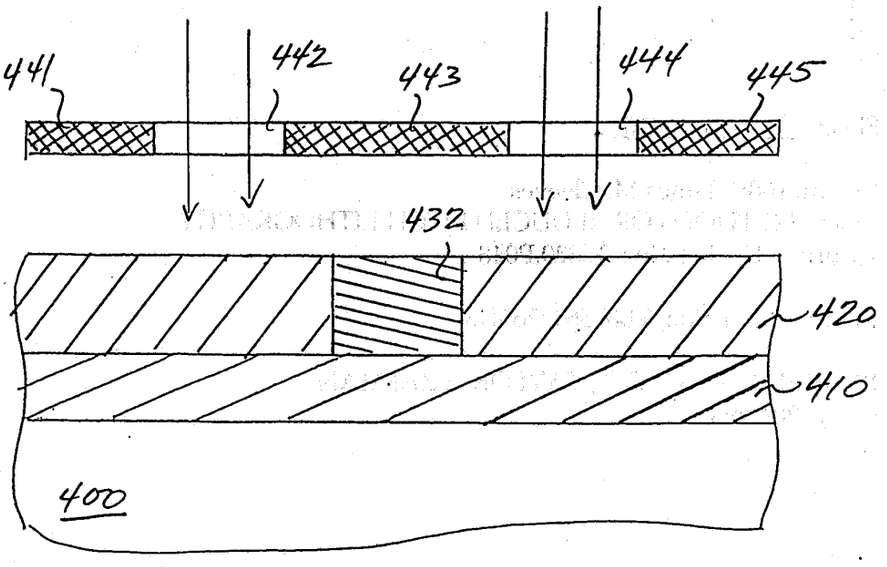

FIG. 9

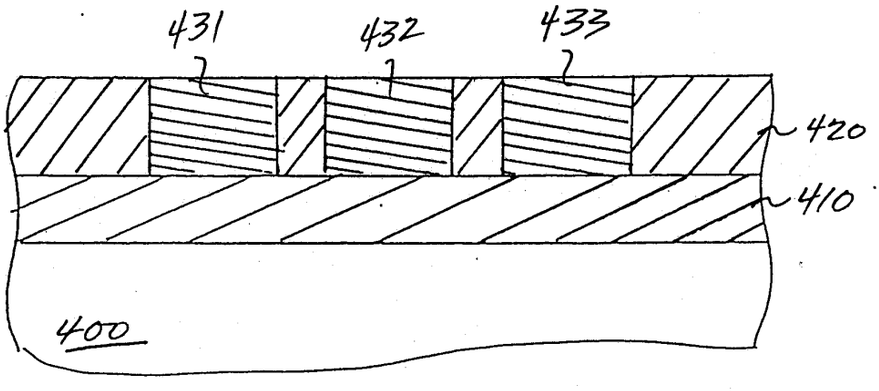

FIG. 10

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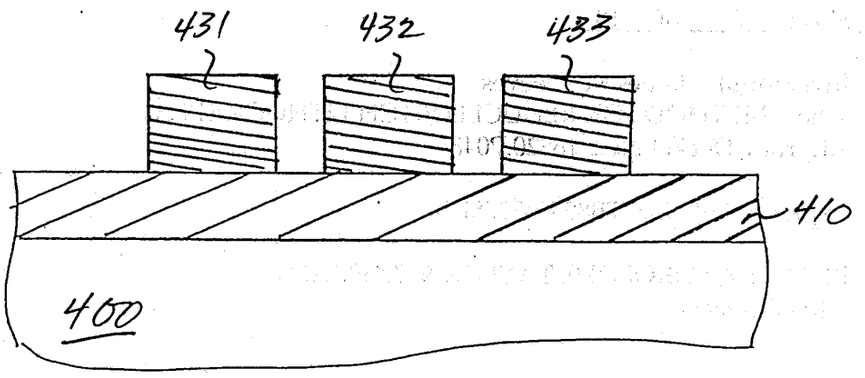

FIG. 11

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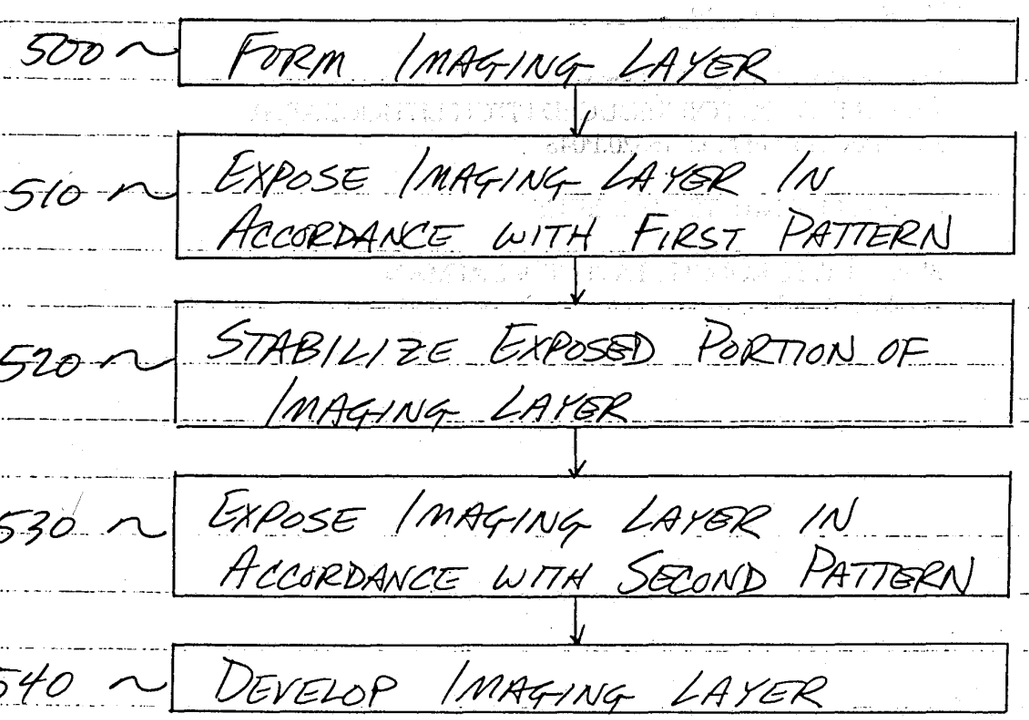

FIG. 12

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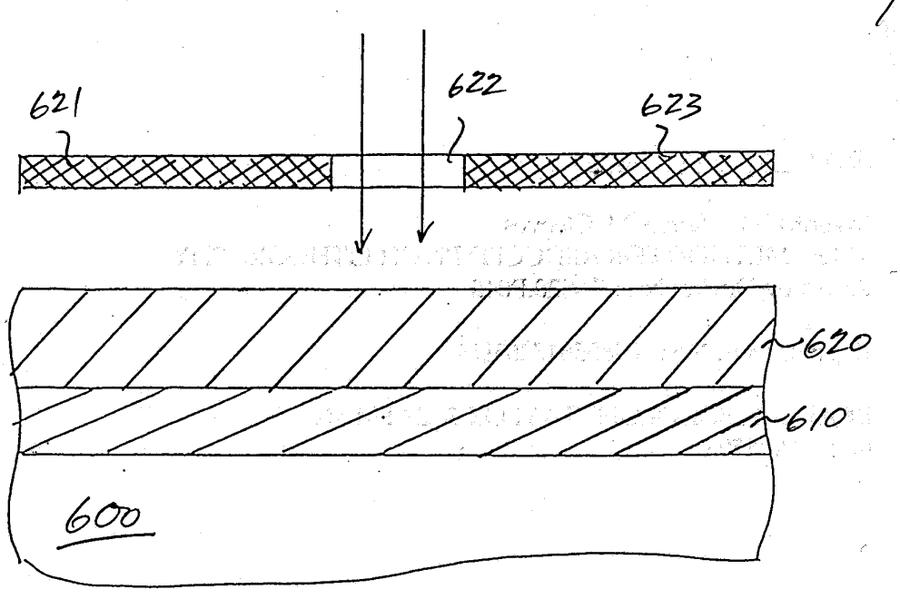

FIG. 13

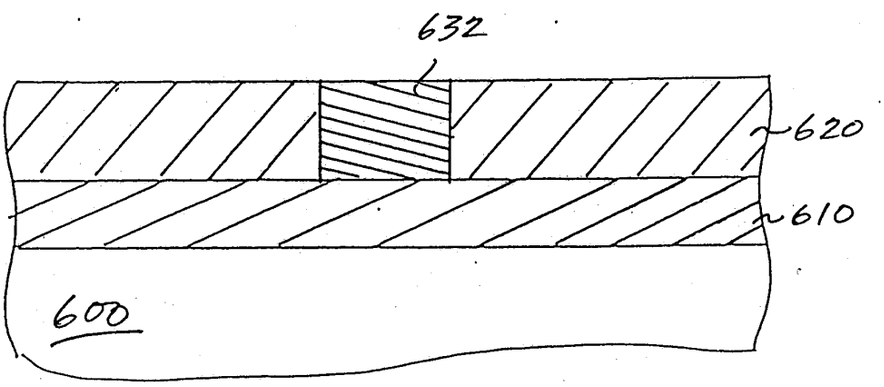

FIG. 14

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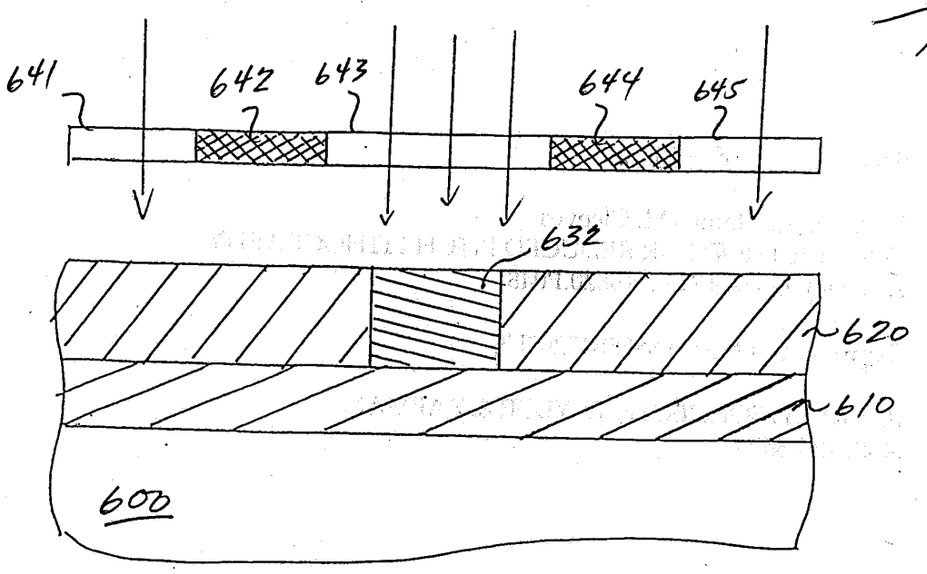

FIG. 15

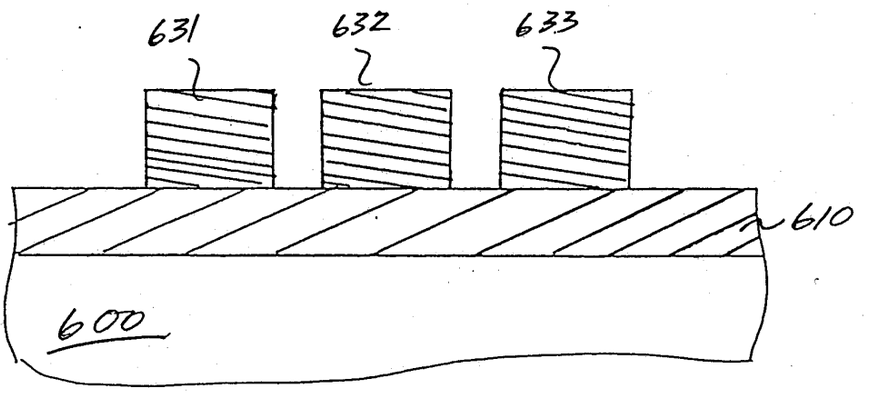

FIG. 16

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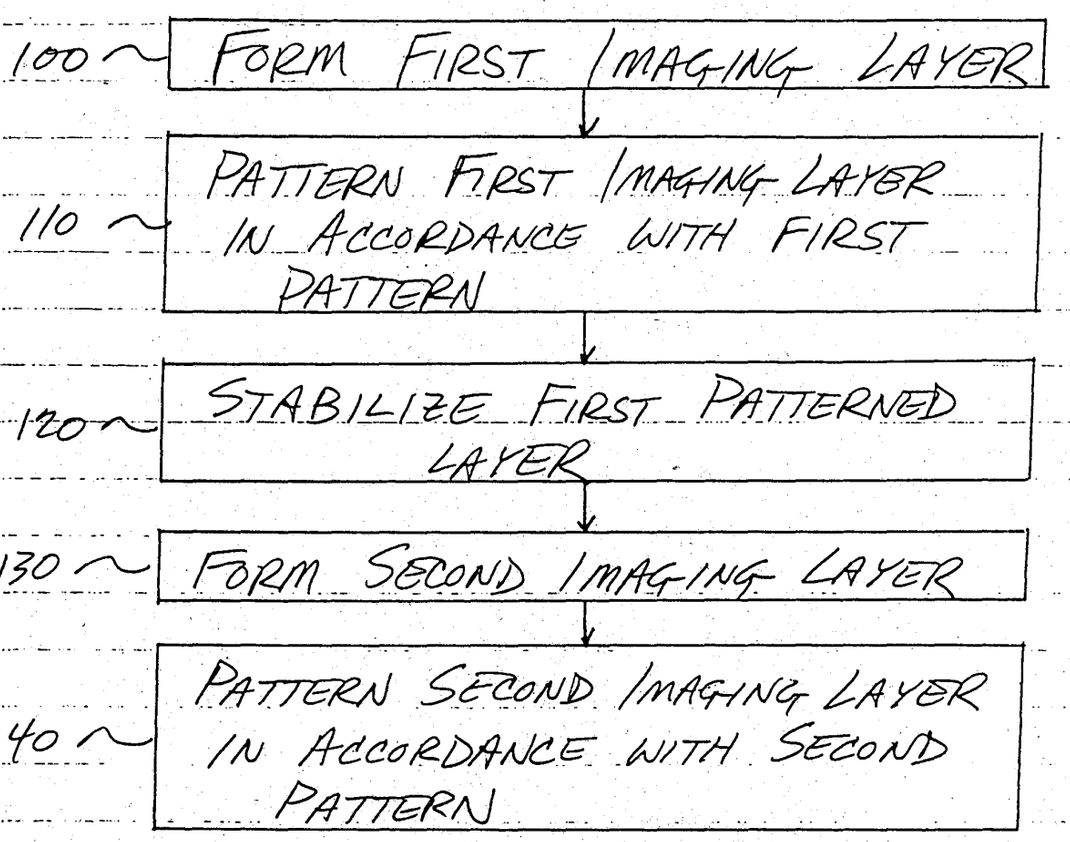

FIG. 1

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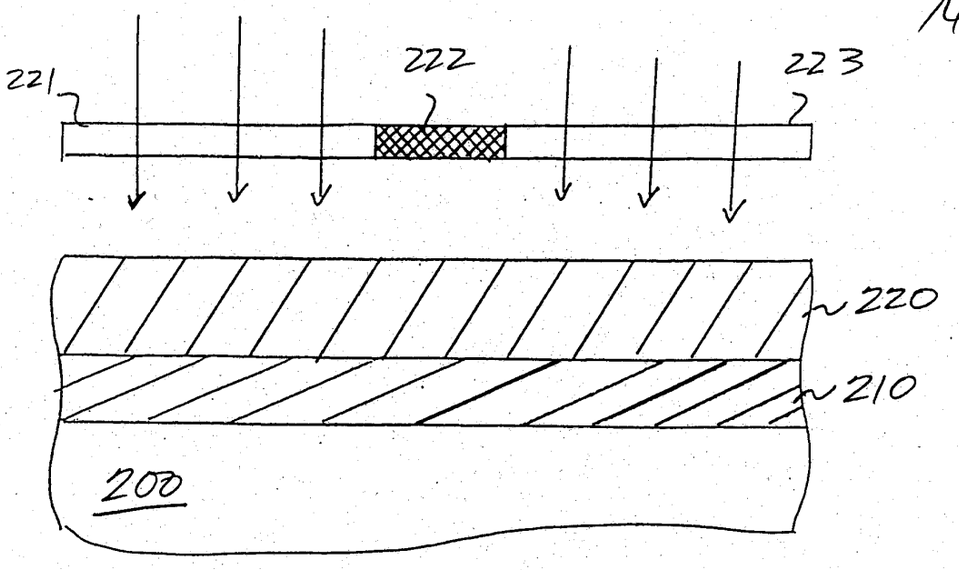

FIG. 2

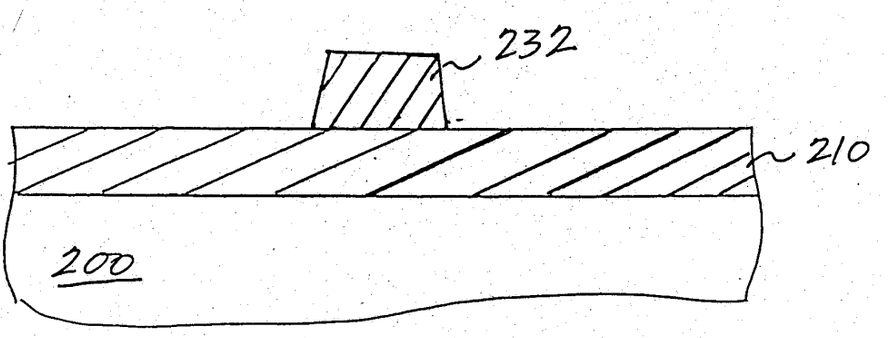

FIG. 3

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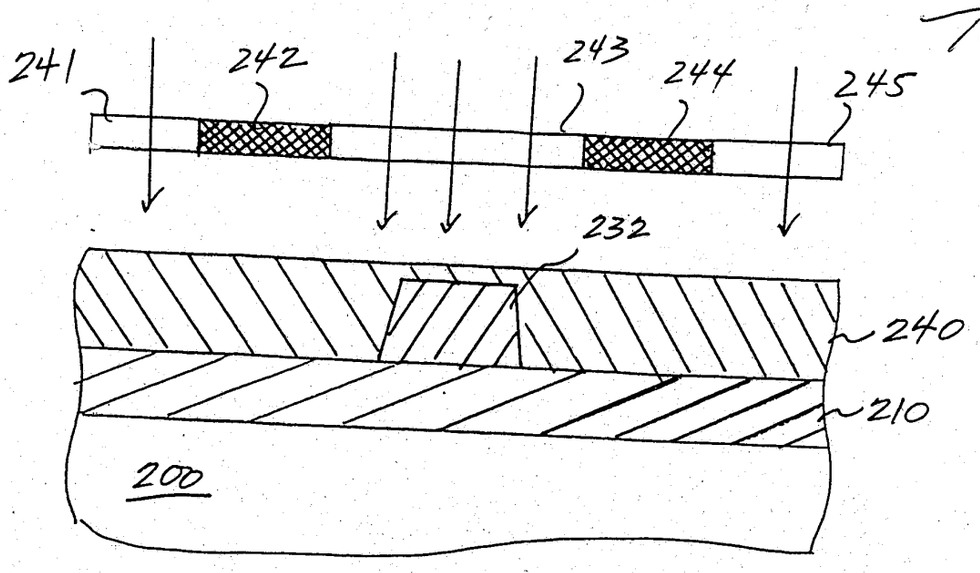

FIG. 4

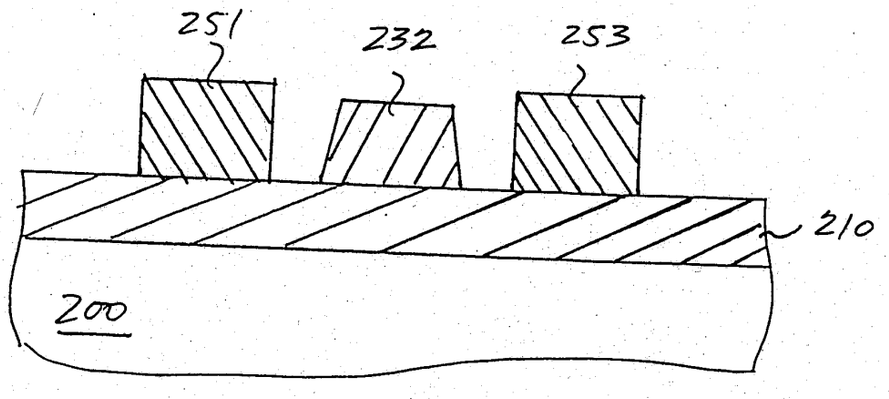

FIG. 5

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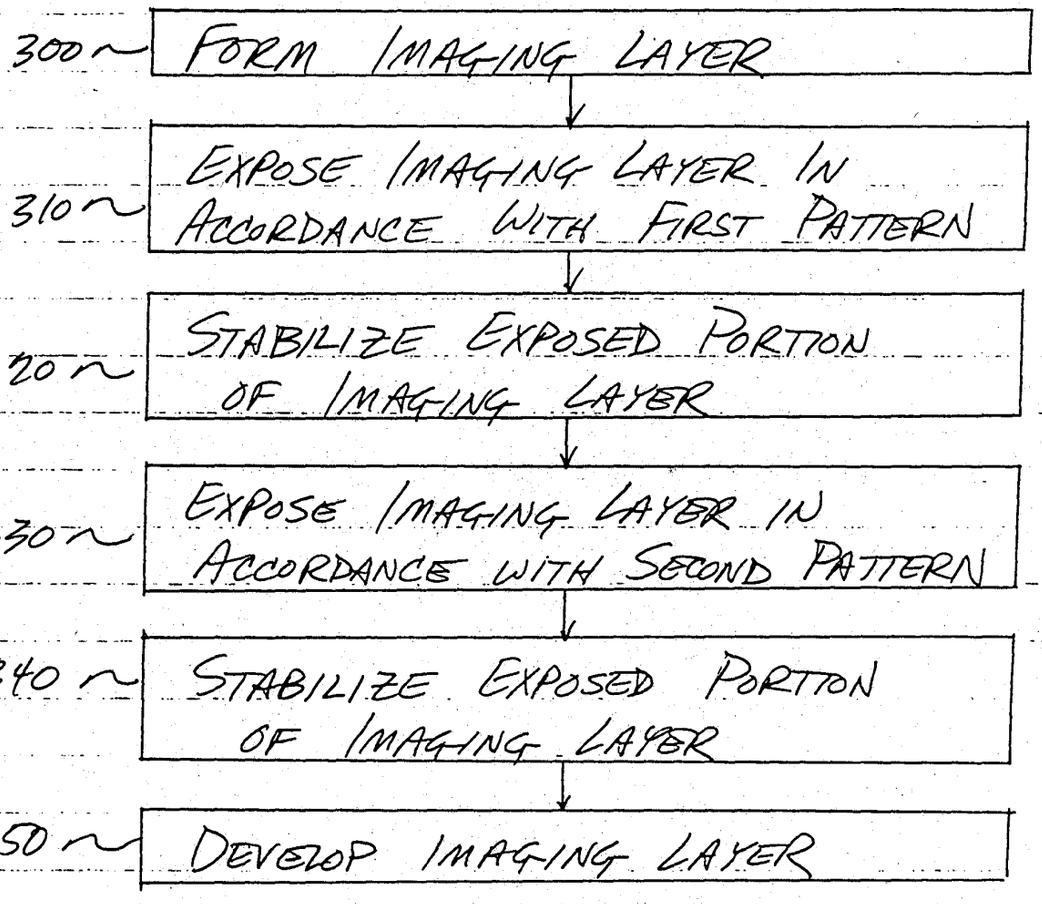

FIG. 6

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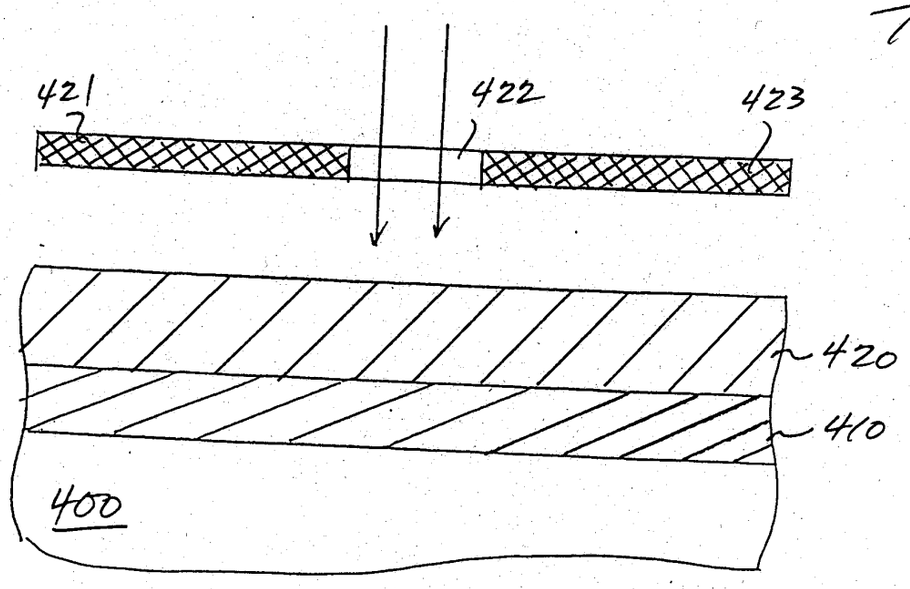

FIG. 7

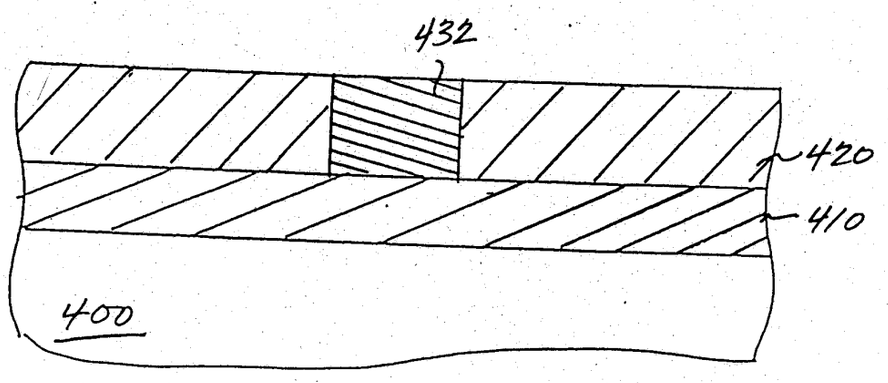

FIG. 8

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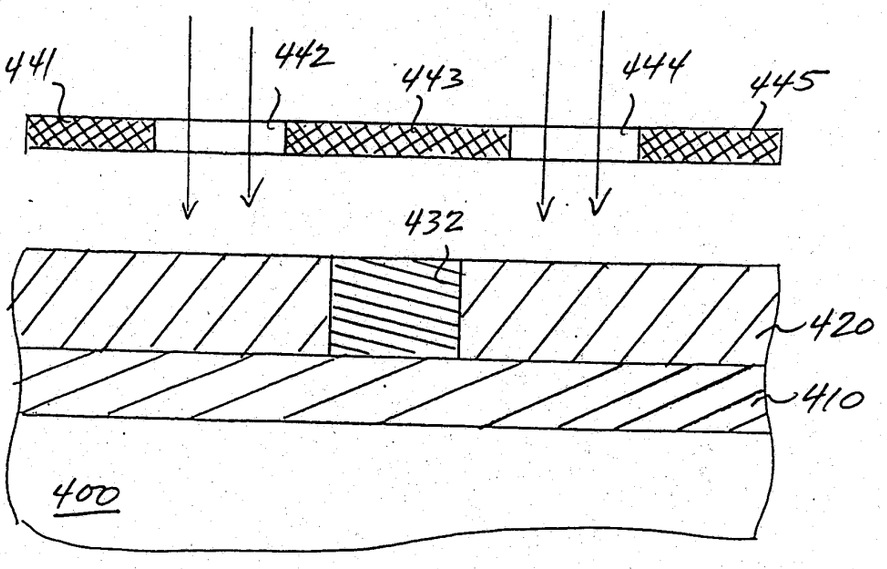

FIG. 9

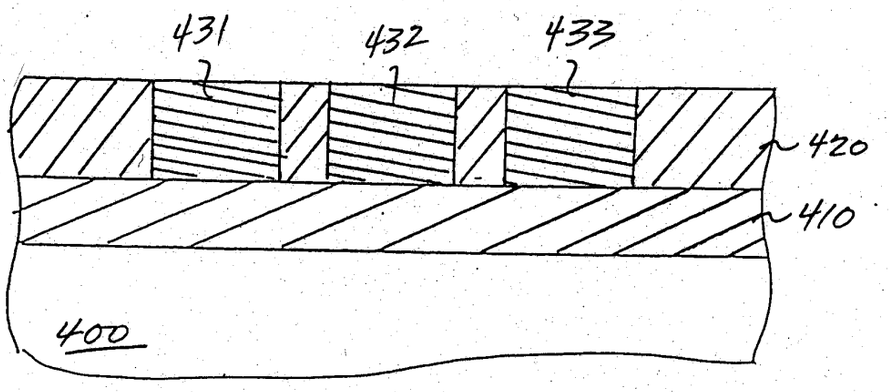

FIG. 10

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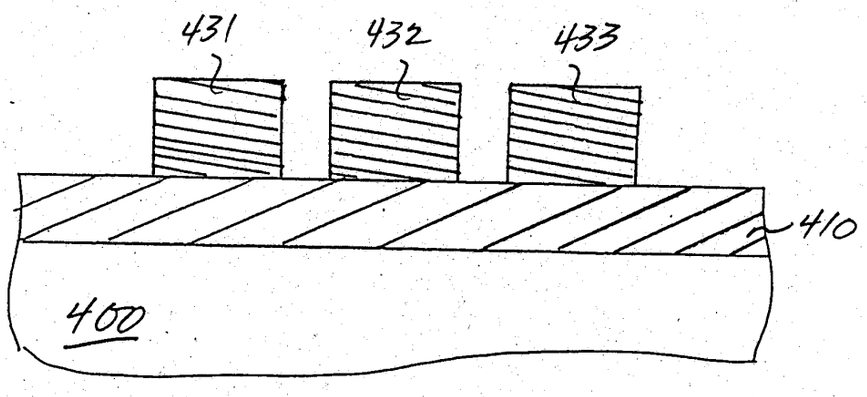

FIG. 11

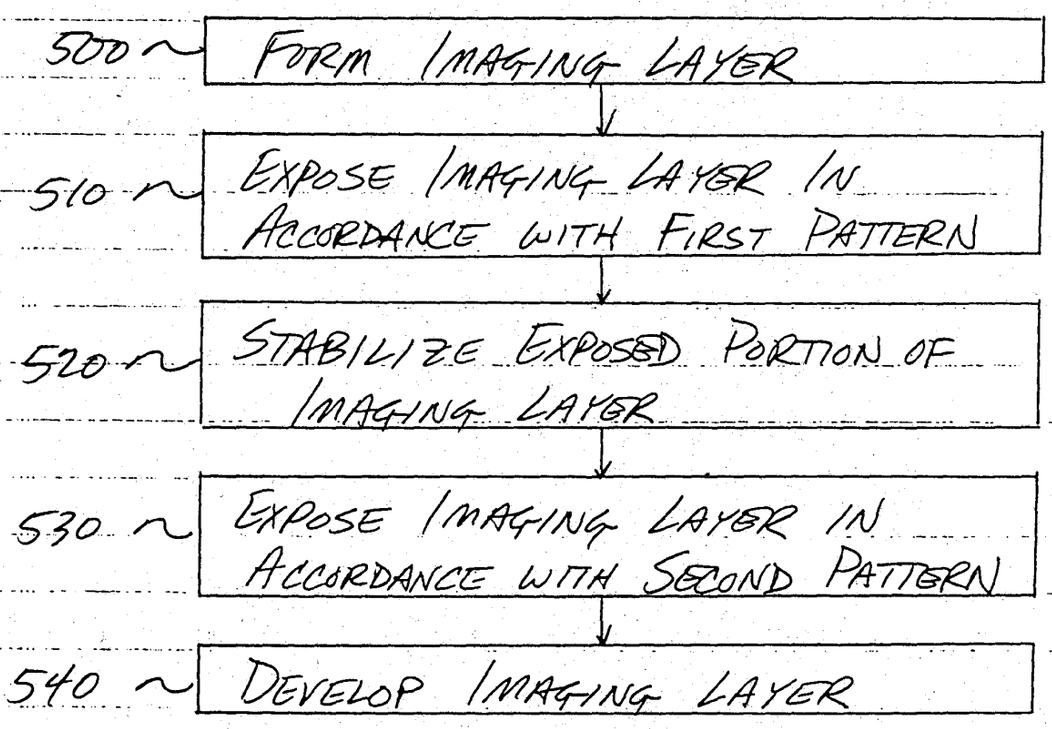
500
FORM IMAGING LAYER
510
EXPOSE IMAGING LAYER IN ACCORDANCE WITH FIRST PATTERN
520
STABILIZE EXPOSED PORTION OF IMAGING LAYER
530
EXPOSE IMAGING LAYER IN ACCORDANCE WITH SECOND PATTERN
540
DEVELOP IMAGING LAYER

FIG. 12

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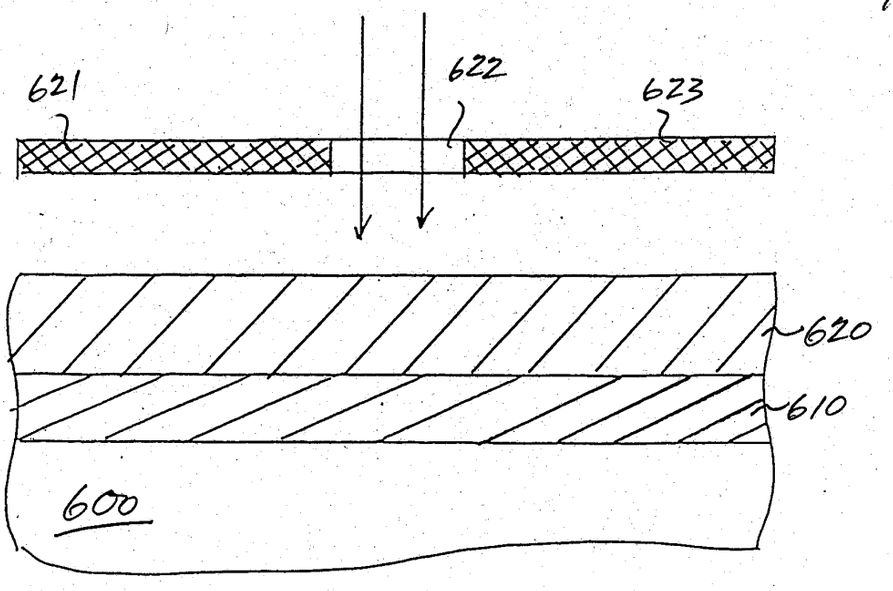

FIG. 13

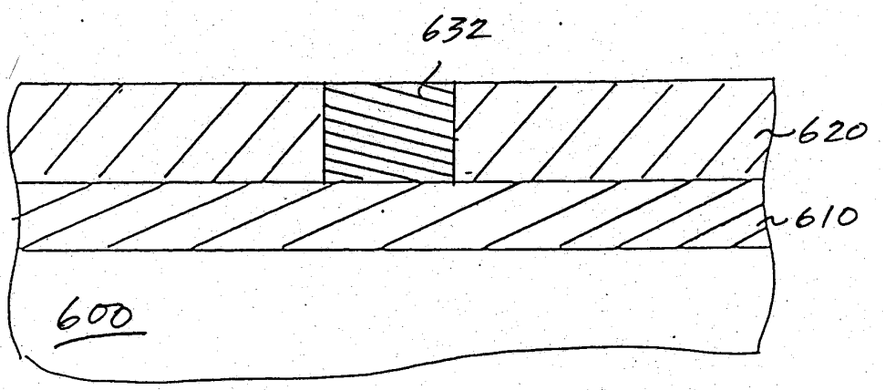

FIG. 14

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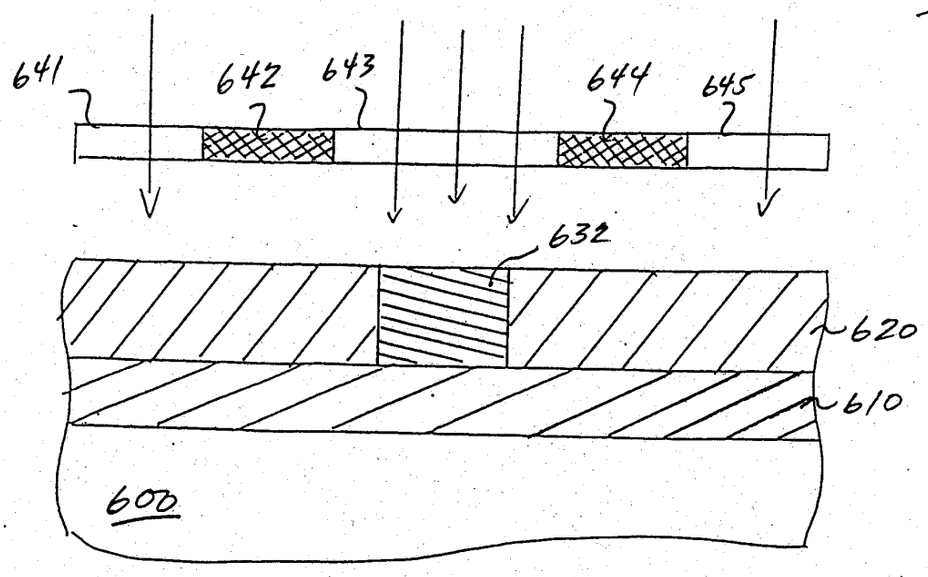

FIG. 15

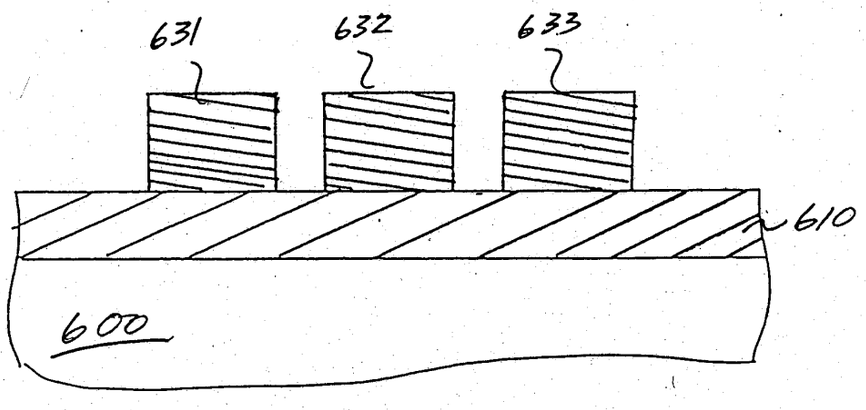

FIG. 16

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/361,595	12/22/94	CLEEVES J	16820.P048

03P1/0201

MATTHEW C FAGAN
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD SEVENTH FLOOR
LOS ANGELES CA 90025

DATE MAILED: 0000

NOTICE TO FILE MISSING PARTS OF APPLICATION FILING DATE GRANTED

02/01/95

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130 for large entities or $ 65 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applicant as a ☑ large entity, ☐ small entity (verified statement filed), is $ 130.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER,** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☐ The statutory basic filing fee is: ☐ missing ☐ insufficient. Applicant as a ☐ large entity ☐ small entity, must submit $_____ to complete the basic filing fee.

2. ☐ Additional claim fees of $_____ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☐ The oath or declaration:
   ☐ is missing.
   ☐ does not cover items omitted at time of execution.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☑ The signature(s) to the oath or declaration is/are: ☑ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   _____ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☐ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $_____ under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $_____ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other

Direct the response and any questions about this notice to, Attention: Application Processing Division, Special Processing and Correspondence Branch (703) 308-1202.

A copy of this notice MUST be returned

OFFICE COPY

[illegible].P048

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:	JAMES M. CLEEVES	)
Serial No.:	08/361,595	)
Filed:	DECEMBER 22, 1994	)
For:	METHOD FOR REDUCED PITCH LITHOGRAPHY	)

Art Unit: NOT YET ASSIGNED

Examiner: NOT YET ASSIGNED

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231

on February 28, 1995
Date of Deposit

Christine A. Bybee
Name of Person Mailing Correspondence

Christine A. Bybee 2-28-95
Signature Date

RESPONSE TO NOTICE TO FILE MISSING PARTS OF APPLICATION (FILING DATE GRANTED)

The Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Attention: Application Processing Division
Special Processing and Correspondence Branch

Sir:

In response to the Notice to File Missing Parts of Application (Filing Date Granted) mailed February 1, 1995, please find enclosed:

(1) a duly executed Declaration and Power of Attorney with respect to the above-referenced patent application;

(2) a check in the amount of $130.00 in payment of the surcharge of 37 C.F.R. § 1.16(e); and

(3) a copy of the Notice to File Missing Parts of Application.

The Commissioner is hereby authorized to charge any fees in connection with this communication to our Deposit Account No. 02-2666. A duplicate of this transmittal is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: February 28, 1995

Matthew C. Fagan
Registration No. 37,542

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025-1026

Phone: (408) 720-8598
Facsimile: (408) 720-9397

Attorney's Docket No.: 16820.P048 Patent

#3

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD FOR REDUCED PITCH LITHOGRAPHY

the specification of which

_____ is attached hereto.
__X__ was filed on December 22, 1994 as
Application Serial No. 08/361,595
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	Filing Date	(Status -- patented, pending, abandoned)
(Application Serial No.)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint Keith G. Askoff, Reg. No. 33,828; Aloysius T. C. AuYeung, Reg. No. 35,432; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Timothy R. Croll, Reg. No. 36,771; Daniel M. De Vos, Reg. 37,813; Matthew C. Fagan, Reg. No. 37,542; Scot A. Griffin, Reg. No. 38,167; Stephen D. Gross, Reg. No. 31,020; David R. Halvorson, Reg. No. 33,395; Michael D. Hartogs, Reg. No. 36,547; Brian Don Hickman, Reg. No. 35,894; George W Hoover II, Reg. No. 32,992; Paul H. Horstmann, Reg. No. 36,167; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg No. 36,172; Stephen L. King, Reg. No. 19,180; Joseph T. Lin, Reg. No. 38,225; Michael J. Mallie, Reg. No. 36,591; James D. McFarland, Reg. No. 32,544; Anthony C. Murabito, Reg. No. 35,295; Kimberley G. Nobles, Reg. No. 38,255; Ronald W. Reagin, Reg. No. 20,340; James H. Salter, Reg. No. 35,668; Robert A. Saltzberg, Reg. No. 36,910; James C. Scheller, Reg. No. 31,195; Edward W. Scott, IV, Reg. No. 36,000; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; John C. Stattler, Reg. No. 36,285; Edwin H. Taylor, Reg. No. 25,129; Lester J. Vincent, Reg. No. 31,460; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and William Donald Davis, Reg. No. 38,428; Thomas X. Li, Reg. No. 37,079; and Edwin A. Sloane, Reg. No. 34,728; my patent agents; of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

39

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor 100 James M. Cleeves

Inventor's Signature James M. Cleeves Date 2/28/95

Residence Redwood City, California CA Citizenship United States of America
(City, State) (Country)

Post Office Address 551 Summit Drive
Redwood City, California 94062

Full Name of Second/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____
(City, State) (Country)

Post Office Address _____

Full Name of Third/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ Citizenship _____
(City, State) (Country)

Post Office Address _____

130-105 A/N

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/361,595	12/22/94	CLEEVES J	16820.P048

03P1/0201

MATTHEW C FAGAN
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD SEVENTH FLOOR
LOS ANGELES CA 90025

DATE MAILED: 0000

NOTICE TO FILE MISSING PARTS OF APPLICATION
FILING DATE GRANTED

02/01/95

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130 for large entities or $ 65 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applicant as a ☑ large entity, ☐ small entity (verified statement filed), is $ 130.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER,** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☐ The statutory basic filing fee is: ☐ missing ☐ insufficient. Applicant as a ☐ large entity ☐ small entity, must submit $_____ to complete the basic filing fee.

2. ☐ Additional claim fees of $_____ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☐ The oath or declaration:
   ☐ is missing.
   ☐ does not cover items omitted at time of execution.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☑ The signature(s) to the oath or declaration is/are: ☑ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   _____ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☐ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $_____ under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $_____ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other 020 AM 03/23/95 08361595 1 105 130.00 CK

Direct the response and any questions about this notice to, Attention: Application Processing Division, Special Processing and Correspondence Branch (703) 308-1202.

A copy of this notice MUST be returned

COPY TO BE RETURNED

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/361,595	12/22/94	CLEEVES J	16820.1042

DUDA, K
EXAMINER

15N2/0504

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

ART UNIT	PAPER NUMBER
1507	4

DATE MAILED: 05/04/95

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

☒ This application has been examined ☐ Responsive to communication filed on _____ ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), _____ days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☒ Notice of References Cited by Examiner, PTO-892.
2. ☒ Notice of Draftsman's Patent Drawing Review, PTO-948.
3. ☐ Notice of Art Cited by Applicant, PTO-1449.
4. ☐ Notice of Informal Patent Application, PTO-152.
5. ☐ Information on How to Effect Drawing Changes, PTO-1474.
6. ☐ _____.

Part II SUMMARY OF ACTION

1. ☒ Claims 1-22 are pending in the application.
   Of the above, claims 12-22 are withdrawn from consideration.
2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 1-11 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice of Draftsman's Patent Drawing Review, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____. has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☐ Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☐ not been received ☐ been filed in parent application, serial no. _____ ; filed on _____.
13. ☐ Since this application apppears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

PTOL-326 (Rev. 2/93)

Part III DETAILED ACTION

Election/Restriction

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

Group I. Claims 1-11, drawn to semiconductor fabrication method, classified in Class 430, subclass 311.

Group II. Claims 12-22, drawn to semiconductor fabrication method, classified in Class 430, subclass 394.

The inventions are distinct, each from the other because of the following reasons:

The two methods differ in that the method of Group I involves the stabilization of a developed resist pattern while the method of Group II involves the stabilization of an exposed undeveloped resist. The two Groups form two distinct and patentably different methods of semiconductor fabrication.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

2. During a telephone conversation with Mr. Jim Scheller on April 21, 1995 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-11. Affirmation of this election must be made by applicant in responding to this

Office action. Claims 12-22 are withdrawn from further consideration by the Examiner, 37 C.F.R. § 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 112

3. Claims 1-11 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 is not clear in reciting in step (a) that the layer is formed "over" the wafer. Perhaps "on"?

Claim 1 is indefinite in step (d) in reciting that the first layer is "surrounded" by the second layer.

Claims 4 and 5, step (i) is indefinite in reciting that "a portion" of the layer is exposed to "radiation in accordance with the first pattern". If the radiation is patterned then it is confusing to recite "a portion".

Claim 8 is indefinite in reciting "prist" without explanation of the process or capitalizing.

Claim 9, "silation" is misspelled.

Claim 10 is indefinite since the specification teaches that steps (i) and (ii) occur simultaneously (page 8).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

5. Claims 1, 6, 10 and 11 are rejected under 35 U.S.C. § 103 as being unpatentable over Orvek (US Patent 4,826,756).

Orvek teaches a process of lithographic patterning whereby a novolak photoresist is patterned. The resist is then hardened by exposing to radiation of a wavelength between 300 to 320 nm and heating. The process occurs in semiconductor processing and further processing after the hardening is taught to occur.

Therefore, it would have been obvious to one of ordinary skill in the art to have stabilized a resist pattern by radiation and heat because Orvek teaches the hardening of a resist pattern by radiation and heat in a lithographic process.

6. Claims 1, 2, 4, 6, 10 and 11 are rejected under 35 U.S.C. § 103 as being unpatentable over Matthews (US Patent 4,548,688).

Matthews teaches a process of hardening a positive photoresist pattern. The pattern is hardened by exposing to radiation with a wavelength of about 320 nm or less and at an elevated temperature.

Therefore, it would have been obvious to one of ordinary skill in the art to have stabilized a resist pattern by radiation and heat because Matthews teaches hardening a positive photoresist pattern with radiation and heat in semiconductor device formation.

7. Claims 1-8, 10 and 11 are rejected under 35 U.S.C. § 103 as being unpatentable over Collins (US Patent 4,904,866).

Collins teaches the conventionality of stabilizing a patterned photoresist with deep UV hardening or PRIST. Collins teaches the stabilization of a photoresist pattern with an electron beam and describes further processing after stabilization of the pattern.

Therefore, it would have been obvious to have stabilized a photoresist pattern before further processing because Collins teaches the conventionality of using deep UV or PRIST to stabilize a photoresist pattern before further processing of the substrate occurs.

8. Claims 1, 6 and 9 are rejected under 35 U.S.C. § 103 as being unpatentable over McColgin (US Patent 4,931,351).

McColgin teaches a lithographic process whereby a photoresist pattern is formed and then silylated before further processing of the substrate occurs.

Therefore, it would have been obvious to have stabilized a photoreisst pattern using a silylation process because McColgin teaches silylation of a photoreisst pattern and then further processing of the substrate.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Angelopolus (US Patent 5,300,403) teaches hardening of a polyimide pattern with exposure to radiation and heating.

10. Any inquiry concerning this communication should be directed to Examiner K. Duda at telephone number (703) 308-2351.

K Duda

KATHLEEN DUDA
PATENT EXAMINER
GROUP 1500

kad
4-30-95

FORM PTO-892 (mod. 3/94)	U.S. DEPARTMENT OF COMMERCE PATENT & TRADEMARK OFFICE	SERIAL NO. 74014S 08/361,595	GROUP ART UNIT 1507 1713	ATTACHMENT TO PAPER NUMBER	4
NOTICE OF REFERENCES CITED		APPLICANT(S) Cleeves			

U.S. PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE
	A	4,548,688	10/1985	Matthews	430	325	
	B	4,826,756	5/1989	Orvek	430	328	
	C	4,904,866	2/1990	Collins	250	492.2	
	D	4,931,351	6/1990	McColgin	430	323	
	E	5,300,403	4/1994	Angelopolus	430	325	6/1992
	F						
	G						
	H						
	I						
	J						
	K						

FOREIGN PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS	PERTINENT SHTS/DWG	PERTINENT PP/SPEC.
	L								
	M								
	N								
	O								
	P								
	Q								

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

R	
S	
T	
U	

EXAMINER	DATE	
K. Duda	5/1/95	Page 1 of 1

* A copy of this reference is not being furnished with this office action.
(See Manual of Patent Examining Procedure, section 707.05(a).)

Form PTO 948 (Rev. 10-94) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office Application No. 361595

NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

PTO Draftpersons review all originally filed drawings regardless of whether they are designated as formal or informal. Additionally, patent Examiners will review the drawings for compliance with the regulations. Direct telephone inquiries concerning this review to the Drawing Review Branch, 703-305-8404.

The drawings filed (insert date) 12/22/94, are
A. ___ not objected to by the Draftsperson under 37 CFR 1.84 or 1.152.
B. X objected to by the Draftsperson under 37 CFR 1.84 or 1.152 as indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawings must be submitted according to the instructions on the back of this Notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings: Black ink. Color.
   - ___ Not black solid lines. Fig(s)___
   - ___ Color drawings are not acceptable until petition is granted. Fig(s) ___
2. PHOTOGRAPHS. 37 CFR 1.84(b)
   - ___ Photographs are not acceptable until petition is granted. Fig(s) ___
   - ___ Photographs not properly mounted (must use brystol board or photographic double-weight paper). Fig(s)___
   - ___ Poor quality (half-tone). Fig(s)___
3. GRAPHIC FORMS. 37 CFR 1.84 (d)
   - ___ Chemical or mathematical formula not labeled as separate figure. Fig(s)___
   - ___ Group of waveforms not presented as a single figure, using common vertical axis with time extending along horizontal axis. Fig(s)___
   - ___ Individuals waveform not identified with a separate letter designation adjacent to the vertical axis. Fig(s)___
4. TYPE OF PAPER. 37 CFR 1.84(c)
   - ___ Paper not flexible, strong, white, smooth, nonshiny, and durable. Sheet(s)___
   - ___ Erasures, alterations, overwritings, interlineations, cracks, creases, and folds copy machine marks not accepted. Fig(s) ___
   - ___ Mylar, velum paper is not acceptable (too thin). Fig(s) ___
5. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:
   - 21.6 cm. by 35.6 cm. (8 1/2 by 14 inches)
   - 21.6 cm. by 33.1 cm. (8 1/2 by 13 inches)
   - 21.6 cm. by 27.9 cm. (8 1/2 by 11 inches)
   - 21.0 cm. by 29.7 cm. (DIN size A4)
   - ___ All drawing sheets not the same size. Sheet(s)___
   - ___ Drawing sheet not an acceptable size. Sheet(s) ___
6. MARGINS. 37 CFR 1.84(g): Acceptable margins:

Paper size

21.6 cm. X 35.6 cm. (8 1/2 X 14 inches)	21.6 cm X 33.1 cm. (8 1/2 X 13 inches)	21.6 cm. X 27.9 cm. (8 1/2 X 11 inches)	21.0 cm. X 29.7 cm. (DIN Size A4)
T 5.1 cm. (2")	2.5 cm. (1")	2.5 cm. (1")	2.5cm.
L .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	2.5 cm.
R .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.5 cm.
B .64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.0 cm.

Margins do conform to chart above.
Sheet(s)___
___Top (T) ___Left (L) ___Right (R) ___Bottom (B)

7. VIEWS. 37 CFR 1.84(h)
   REMINDER: Specification may require revision to correspond to drawing changes.
   - ___ All views not grouped together. Fig(s)___
   - ___ Views connected by projection lines or lead lines. Fig(s)___
   - Partial views. 37 CFR 1.84(h) 2
   - ___ View and enlarged view not labled separatly or properly. Fig(s)___
   - Sectional views. 37 CFR 1.84 (h) 3
   - ___ Hatching not indicated for sectional portions of an object. Fig(s)___
   - ___ Cross section not drawn same as view with parts in cross section with regularly spaced parallel oblique strokes. Fig(s)___
8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)
   - ___ Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s)___
9. SCALE. 37 CFR 1.84(k)
   - ___ Scale not large enough to show mechanism with crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s)___
   - ___ Indication such as "actual size" or scale 1/2" not permitted. Fig(s)___
10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(l)
    - X ___ Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (except for color drawings). Fig(s) 1-10
11. SHADING. 37 CFR 1.84(m)
    - ___ Solid black shading areas not permitted. Fig(s)___
    - ___ Shade lines, pale, rough and blurred. Fig(s)___
12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)
    - ___ Numbers and reference characters not plain and legible. 37 CFR 1.84(p)(l) Fig(s)___
    - ___ Numbers and reference characters not oriented in same direction as the view. 37 CFR 1.84(p)(l) Fig(s)___
    - ___ English alphabet not used. 37 CFR 1.84(p)(2) Fig(s)___
    - ___ Numbers, letters, and reference characters do not measure at least .32 cm. (1/8 inch) in height. 37 CFR(p)(3) Fig(s)___
13. LEAD LINES. 37 CFR 1.84(q)
    - ___ Lead lines cross each other. Fig(s)___
    - ___ Lead lines missing. Fig(s)___
14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)
    - ___ Sheets not numbered consecutively, and in Arabic numerals, beginning with number 1. Sheet(s)___
15. NUMBER OF VIEWS. 37 CFR 1.84(u)
    - ___ Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s)___
    - ___ View numbers not preceded by the abbreviation Fig. Fig(s)___
16. CORRECTIONS. 37 CFR 1.84(w)
    - ___ Corrections not made from prior PTO-948. Fig(s)___
17. DESIGN DRAWING. 37 CFR 1.152
    - ___ Surface shading shown not appropriate. Fig(s)___
    - ___ Solid black shading not used for color contrast. Fig(s)___

COMMENTS:

ATTACHMENT TO PAPER NO. 4 REVIEWER ___ DATE 4/5/95

PTO Copy

REMINDER

Drawing changes may also require changes in the specification, e.g., if Fig. 1 is changed to Fig. 1A, Fig. 1B, Fig. 1C, etc., the specification, at the Brief Description of the Drawings, must likewise be changed. Please make such changes by 37 CFR 1.312 Amendment at the time of submitting drawing changes.

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

1. Correction of Informalities--37 CFR 1.85

File new drawings with the changes incorporated therein. The application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application, should be placed on the back of each sheet of drawings in accordance with 37 CFR 1.84(c). Applicant may delay filing of the new drawings until receipt of the Notice of Allowability (PTOL-37). Extensions of time may be obtained under the provisions of 37 CFR1.136. The drawing should be filed as a separate paper with a transmittal letter addressed to the Drawing Review Branch.

2. Timing of Corrections

Applicant is required to submit **acceptable** corrected drawings within the three-month shortened statutory period set in the Notice of Allowability (PTOL-37). If a correction is determined to be unacceptable by the Office, applicant must arrange to have acceptable correction resubmitted within the original three-month period to avoid the necessity of obtaining as extension of time and paying the extension fee. Therefore, applicant should file corrected drawings as soon as possible.

Failure to take corrective action within set (or extended) period will result in **ABANDONMENT** of the Application.

3. Corrections other than Informalities Noted by the Drawing Review Branch on the Form PTO 948

All changes to the drawings, other than informalities noted by the Drawing Review Branch, **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.

04/04/95 U3 00
Ca 2380 3-25-95
Chg Loc, 0500
1506

16820.P048 *Patent*

#5 wm 5/11/95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:	James M. Cleeves	)	Art Unit: Not Yet Assigned
Serial No.:	08/361,595	)	Examiner: Not Yet Assigned
Filed:	December 22, 1994	)	
For:	METHOD FOR REDUCED PITCH LITHOGRAPHY	)	

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231

on March 21, 1995
Date of Deposit

Christine A. Bybee
Name of Person Mailing Correspondence

Christine A. Bybee 3-21-95
Signature Date

15C

INFORMATION DISCLOSURE STATEMENT

The Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Enclosed is a copy of Information Disclosure Citation Form PTO-1449 together with copies of the documents cited on that form. It is respectfully requested that the cited documents be considered and that the enclosed copy of Form PTO-1449 be initialed by the Examiner to indicate such consideration and copy thereof returned to the Applicant.

This Information Disclosure Statement is being submitted pursuant to 37 C.F.R. § 1.97(b).

Pursuant to 37 C.F.R. § 1.97, the submission of this Information Disclosure Statement is not to be construed as a representation that a search has been made and is

not to be construed as an admission that the information cited in this statement is material to patentability.

The Commissioner is hereby authorized to charge any fees in connection with this communication to our Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: March 21, 1995

Matthew C. Fagan
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Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.	SERIAL NO.
16820.P048	740145 ~~08/361,595~~

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

APPLICANT: James M. Cleeves

FILING DATE	GROUP
December 22, 1994	1113 ~~Not Yet Assigned~~

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
KMD		4,908,656	3/1990	Suwa, et al.	355	53	—

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

KMD		"Method to Incorporate Three Sets of Pattern Information in Two Photomasking Steps," IBM Technical Disclosure Bulletin, Vol. 32, No. 8A, pp. 218-219 (January 1990).
KMD		"Dual-Image Resist for Single-Exposure Self-Aligned Processing," IBM Technical Disclosure Bulletin, Vol. 33, No. 2, pp. 447-449 (July 1990).
KMD		"Complementary Selective Writing by Direct-Write E-Beam/Optical Lithography Using Mixed Positive and Negative Resist," IBM Technical Disclosure Bulletin, Vol. 33, No. 3A, pp. 62-63 (August 1990).
KMD		"Sub-Micron Channel Length CMOS Technology," IBM Technical Disclosure Bulletin, Vol. 33, No. 4, pp. 227-232 (September 1990).
KMD		"Multilayer Circuit Fabrication Using Double Exposure of Positive Resist," IBM Technical Disclosure Bulletin, Vol. 36, No. 10, pp. 423-424 (October 1993).

EXAMINER	DATE CONSIDERED
K. Duda	10-26-95

*EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

ATTY. DOCKET NO.	SERIAL NO.
16820.P048	~~08/361,595~~ 740145

APPLICANT: James M. Cleeves

FILING DATE	GROUP
December 22, 1994	~~Not Yet Assigned~~ 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

ICAD			Wolf, S., et al., Silicon Processing for the VLSI Era, Volume 1: Process Technology, Lattice Press, Sunset Beach, California, pp. 407-458 (1986).

EXAMINER	DATE CONSIDERED
K. Duda	10-26-95

*EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Attorney's Docket No.: 42390.P048 Patent

In the Application of: James M. Cleeves
(inventor(s))

Serial No.: 08/361,595

Filed: December 22, 1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY
(title)

BOX: Non-Fee Amendment
THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SIR: Transmitted herewith is an **Amendment** for the above application.

_____ Small entity status of this application under 37 C.F.R. §§ 1.9 and 1.27 has been established by a verified statement previously submitted.
_____ A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 is enclosed.
__XX__ No additional fee is required.

The fee has been calculated as shown below:

	(Col. 1) Claims Remaining After Amd.		(Col. 2) Highest No. Previously Paid For	(Col. 3) Present Extra	SMALL ENTITY Rate	SMALL ENTITY Additional Fee	OTHER THAN A SMALL ENTITY Rate	OTHER THAN A SMALL ENTITY Additional Fee
Total Claims	* 11	Minus	** 20	-0-	x11	$	x22	$ -0-
Indep. Claims	* 1	Minus	*** 3	-0-	x37	$	x74	$ -0-
☐ **First Presentation of Multiple Dependent Claim(s)**					**+115**	**$**	**+230**	**$**
					Total Add. Fee	$ -0-	Total Add. Fee	$ -0-

* If the entry in Col. 1 is less than the entry in Col. 2, write "0" in Col. 3.
** If the "Highest No. Previously Paid For" IN THIS SPACE is less than 20, write "20" in this space.
*** If the "Highest No. Previously Paid For" IN THIS SPACE is less than 3, write "3" in this space. The "Highest No. Previously Paid For" (Total or Independent) is the highest number found from the equivalent box in Col. 1 of a prior amendment or the number of claims originally filed.

_____ A check in the amount of $_____ is attached for presentation of additional claim(s).
_____ Applicant(s) hereby Petition(s) for an Extension of Time of _____ month(s) pursuant to 37 C.F.R. § 1.136(a).
_____ A check for $_____ is attached for processing fees under 37 C.F.R. § 1.17.
_____ Please charge my Deposit Account No. 02-2666 the amount of $_____.
A duplicate copy of this sheet is enclosed.
__X__ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 02-2666
(a duplicate copy of this sheet is enclosed):
__X__ Any additional filing fees required under 37 C.F.R. § 1.16 for presentation of extra claims.
__X__ Any extension or petition fees under 37 C.F.R. § 1.17.

BLAKELY SOKOLOFF TAYLOR & ZAFMAN

Date: 8/1/95

Michael A. Bernadicou

Reg. No. 35,934

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Seventh Floor
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(408) 720-8598

FIRST CLASS CERTIFICATE OF MAILING
(37 C.F.R. § 1.8(a))

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class mail, in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on: 8-1-95.

Name: Alice Tam 8-1-95
Date

(LJV/cak 11/23/92)

DUDA
041
8/11

16820.P048 *Patent*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

James M. Cleeves

Serial No: 08/361,595

Filed: December 22, 1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Unit: 1507

#1A
6/W.M
8/18/95

AMENDMENT AND RESPONSE

Box: Non-Fee Amendment
Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Commissioner:

This is in response to the Office Action mailed **May 4, 1995**. Applicant respectfully requests the Examiner to enter the following amendments and consider the following remarks. Reconsideration and reexamination of the above-referenced application is respectfully requested.

IN THE SPECIFICATION

On page 9, line 9, please delete the word "silation" and insert --silylation-- therein.

IN THE CLAIMS

8. (Amended) The method of claim 1, wherein the stabilizing step (c) includes the step of using a [prist] PRIST technique to stabilize the first patterned layer.

A1

9. (Amended) The method of claim 1, wherein the stabilizing step (c) includes the step of using a [silation] silylation technique to stabilize the first patterned layer.

REMARKS

Applicant hereby affirms his election to prosecute Group I claims, claims 1-11, drawn to a semiconductor fabrication method and hereby withdraws Group II claims, claims 12-22.

The Examiner has rejected claims 1-11 as being indefinite for failing to particularly point out and distinctly claims the subject matter which the applicant regards as the invention. It is applicant's understanding that claims 1, 4, 5, and 10 use such clear and concise language so as to allow anyone skilled in the art to ascertain the leaps and bounds of the present invention. Applicant has amended Claims 8 and 9 to more particularly point out and distinctly claim the subject matter which Applicant regards as the invention. As such, Applicant respectfully requests the removal of the 35 U.S.C. §112 second paragraph rejections of Claims 1-11.

The Examiner has rejected Claims 1, 6, 10, and 11 under 35 U.S.C. §103 as being unpatentable over Orvek. It is the Examiner's position that Orvek teaches a process for lithographic patterning whereby a novolak photoresist pattern is harden by exposing the pattern to radiation of a wavelength between 300 -320 nanometers and heating. It is further the Examiner's position that it would have been obvious to one of ordinary skill in the art to have stabilized a resist pattern by radiation in heat because Orvek teaches the hardening of a resist pattern by radiation and heat in a lithographic process.

It is Applicant's understanding that Orvek fails to teach or render obvious Applicant's invention as claimed in Claims 1, 6, 10 and 11. Applicant claims in independent claim 1:

> *"(d) forming a second imaging layer over the first patterned layer such that the first patterned layer is surrounded by the second imaging layer; and*
> *(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer."* (Emphasis added)

That is, Applicant claims a process of forming a single patterned masking layer by separately forming and patterning two separate layers. In this way, Applicant is able to form a single masking layer which has feature densities greater than that which is possible from a single masking layer formed with a single patterning step. Applicant's novel masking technique allows high density integrated circuits to be fabricated.

It is Applicant's understanding that Orvek fails to teach or render obvious Applicant's invention as claimed. As stated by the Examiner, Orvek does teach a method of hardening a photoresist layer. However, Orvek fails to teach or

render obvious *"...forming a second imaging layer over the first patterned layer..."* and *"...patterning the second imaging layer..."* as claimed by Applicant. Therefore, for at least this reason, Orvek fails to teach or render obvious Applicant's invention as claimed in Claims 1, 6, 10, and 11.

The Examiner has also rejected Claims 1, 2, 4, 6, 10, and 11 under 35 U.S.C. §103 as being unpatentable over Matthews. Matthews teaches a process of hardening the photoresist pattern wherein the photoresist pattern is hardened by exposing it to radiation with wavelengths of about 320 nanometers or less at an elevated temperature. Like Orvek, however, Matthews fails to teach or render obvious Applicant's claimed steps of *"...forming a second imaging layer over the first patterned layer..."* and *"...patterning the second imaging layer..."* As such, for at least this reason, Matthews fails to teach and render obvious Applicant's invention as claimed in Claims 1, 2, 4, 6, 10, and 11.

The Examiner has also rejected claims 1-8, 10 and 11 under 35 U.S.C. §103 as being unpatentable over Collins. Collins teaches a method of stabilizing a pattern photoresist with deep UV hardening or PRIST. Collins, however, also fails to teach *"...forming a second imaging layer over the first patterned layer..."* and *"...patterning the second imaging layer..."* as claimed by Applicant. Collins, therefore, clearly fails to teach or render obvious Applicant's invention as claimed in Claims 1-8, 10 and 11.

The Examiner has also rejected Claims 1, 6, and 9 under 35 U.S.C. §103 as being unpatentable over McColgin. McColgin teaches a photolithographic process whereby a photoresist pattern is formed and then silylated. McColgin, however, fails to teach *"...forming a second imaging layer over the first patterning layer..."* and *"...patterning the second imaging layer..."* as claimed by

Applicant. McColgin, therefore, clearly fails to teach or render obvious Applicant's invention as claimed in Claims 1, 6, and 9.

As such, Applicant respectfully requests the removal of the 35 U.S.C. §103 rejections of claims 1-11 and seeks an early allowance of these claims.

If there are any further charges please charge them to Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 8/1/95

Michael A. Bernadicou
Reg. No. 35,934

12400 Wilshire Boulevard
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Los Angeles, CA 90025-1026
(408) 720-8598

FIRST CLASS CERTIFICATE OF MAILING
(37 C.F.R. § 1.8(a))

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class mail, in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on: August 1, 1995.

Name: Alice Tam 8-1-95
Date

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/361,595	12/22/94	CLEEVES	J 16820.P048

EXAMINER	
DUDA, K	
ART UNIT	**PAPER NUMBER**
1113	7

15N2/1027
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

DATE MAILED: 10/27/95

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

☒ This application has been examined ☒ Responsive to communication filed on 8/4/95 ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), — days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892.
2. ☐ Notice of Draftsman's Patent Drawing Review, PTO-948.
3. ☒ Notice of Art Cited by Applicant, PTO-1449. (2 pp.)
4. ☐ Notice of Informal Patent Application, PTO-152.
5. ☐ Information on How to Effect Drawing Changes, PTO-1474.
6. ☐ _____.

Part II SUMMARY OF ACTION

1. ☒ Claims 1-22 are pending in the application.
   Of the above, claims 12-22 are withdrawn from consideration.
2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 1-11 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice of Draftsman's Patent Drawing Review, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____. has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☐ Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☐ not been received ☐ been filed in parent application, serial no. _____ ; filed on _____.
13. ☐ Since this application apppears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

PTOL-326 (Rev. 2/93)

Part III DETAILED ACTION

Election/Restriction

1. Applicant's election of Group I, claims 1-11 in Paper No. 6 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (M.P.E.P. § 818.03(a)).

2. Claims 12-22 are withdrawn from further consideration by the examiner, 37 C.F.R. § 1.142(b) as being drawn to a nonelected invention. Election was made **without** traverse in Paper No. 6.

Claim Rejections - 35 USC § 112

3. Claims 1-11 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 is not clear in reciting in step (a) that the layer is formed "over" the wafer. Perhaps "on"?

Claim 1 is indefinite in step (d) in reciting that the first layer is "surrounded" by the second layer.

Claims 4 and 5, step (i) is indefinite in reciting that "a portion" of the layer is exposed to "radiation in accordance with

the first pattern". If the radiation is patterned then it is confusing to recite "a portion".

Claim 10 is indefinite since the specification teaches that steps (i) and (ii) occur simultaneously (page 8).

Applicant has not responded to the rejection of these claims except to say the claims use concise language which does not address the specific rejections the Examiner has made.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

5. Claims 1-11 are rejected under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 32, number 8A (Disclosure 1).

Disclosure 1 teaches a method of patterning. The method involves hardening a first photoresist image. A second layer of photoresist is then applied and openings formed which are coincident with the first. It would have been obvious to have formed an image as claimed with a stabilization of the first photoresist image before application of a second photoresist layer because Disclosure 1 teaches such with the second photoresist layer formed within openings of the first photoreisst image.

6. Claims 1-11 are rejected under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 33, number 3A (Disclosure 2).

Disclosure 2 teaches a process for forming an image. The process involves applying a first resist layer to a substrate. The resist is exposed, developed and hardbaked to prevent reflow. An oxide layer is applied followed by a second resist layer. The second resist layer is exposed and developed and used in further processing of the substrate. It would have been obvious to one of skill in the art to have stabilized a first resist pattern before applying a second resist layer to be patterned because Disclosure 2 teaches a process where the stabilization of the first image occurs before further resist processing.

7. Any inquiry concerning this communication should be directed to Examiner K. Duda at telephone number (703) 308-2351 or by FAX at (703) 305-5433.

K Duda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1500 / 1100
~~KATHLEEN DUDA~~
~~PRIMARY EXAMINER~~
~~GROUP 1500~~

kad
10-26-95

110 - 115 CP 1113

Our Docket No.: 16820.P048

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Group: 1113

#8

PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. §1.136(a)

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

Sir:

Applicant herewith petitions the Commissioner of Patents and Trademarks to extend the time for response to the Office Action, mailed October 27, 1995 for one month to February 27, 1996.

Submitted herewith is a check for $110.00, pursuant to 37 C.F.R. §1.17(a), to cover the cost of the extension.

The Commissioner is hereby authorized to charge any fees in connection with this communication to Deposit Account No. 02-2666. A duplicate of this letter is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: February 27, 1996

RBC

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CERTIFICATE OF MAILING

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RBC

February 27, 1996

Name *Date*

270 MM 03/08/96 08361595

1 115 110.00 CK

Our Docket No.: 16820.P048

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Group: 1113

PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. §1.136(a)

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

Sir:

Applicant herewith petitions the Commissioner of Patents and Trademarks to extend the time for response to the Office Action, mailed October 27, 1995 for one month to February 27, 1996.

Submitted herewith is a check for $110.00, pursuant to 37 C.F.R. §1.17(a), to cover the cost of the extension.

The Commissioner is hereby authorized to charge any fees in connection with this communication to Deposit Account No. 02-2666. A duplicate of this letter is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: FEBRUARY 27, 1996

RBC

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CERTIFICATE OF MAILING

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RBC — February 27, 1996

Name — *Date*

Our Docket No.: 16820.P048

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: **METHOD FOR REDUCED PITCH LITHOGRAPHY**

Examiner: Duda, K.

Art Group: 1113

AMENDMENT AND RESPONSE TO THE OFFICE ACTION

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

Sir:

In response to an outstanding Office Action, mailed October 27, 1995, please amend the above-identified application and consider the following remarks.

IN THE SPECIFICATION

On page 10, line 9, delete "silation" and insert --silylation-- therein.

EK30178 03/22/96 08361595 02-2666 030 102 78.00CH

EK30179 03/22/96 08361595 02-2666 030 103 44.00CH

IN THE CLAIMS

Please amend Claims 1, 4, 5, 10 and 11.

Please add Claims 23 and 24.

1. (Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer [such that the first patterned layer is surrounded by the second imaging layer]; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer, wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation.

4. (Amended) The method of claim 1, wherein the patterning step (b) includes the steps of:

(i) exposing a portion of the first imaging layer to radiation [in accordance with the first pattern] ; and

(ii) developing the first imaging layer such that the exposed portion dissolves to form the first patterned layer.

5. (Amended) The method of claim 1, wherein the patterning step (e) includes the steps of:

(i) exposing a portion of the second imaging layer to radiation [in accordance with the second pattern,] ; and

(ii) developing the second imaging layer such that the exposed portion dissolves to form the second patterned layer.

10. (Amended) The method of claim 1, wherein the stabilizing step (c) includes [the steps of]:

[(i)]exposing the first patterned layer to radiation[,] and

[(ii)]heating the first patterned layer.

11. (Amended) The method of claim [10] 1, wherein the [exposing] stabilizing step (c)[(i)] includes [the step of]exposing the first patterned layer to radiation having a wavelength in a range from approximately 200 nanometers to approximately 400 nanometers[;], and

[wherein the heating step (c)(ii) includes the step of]heating the first patterned layer at a temperature ramped to approximately 230 degrees Celsius.

23. (New) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer, wherein the second patterned layer and the first patterned layer together form a single patterned layer of a plurality of

disposable posts, each disposable post being formed relatively closer to other disposable posts than is possible through a single exposure to radiation.

24. (New) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer, wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features, the adjacent features having a pitch which is not limited by a single exposure to radiation.

REMARKS

Reconsideration of this case is respectfully requested in view of the foregoing amendments and these remarks.

I. Election/Restriction

The Office Action dated October 27, 1995, considered the election of Group I, claims 1-11, as being elected without traverse. Applicant acknowledges this designation.

II. Claim Rejections under 35 U.S.C. §112, second paragraph.

The Office Action dated October 27, 1995, rejected Claims 1-11 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant submits that Claims 1-11 as present amended distinctly claim the subject matter which Applicant regards as the invention.

Additionally, Applicant submits that step (a) of Claim 1 is clear in reciting that a first imaging layer is formed "over" a semiconductor wafer. One skilled in the art would understand the meaning of forming an imaging layer "over" a semiconductor wafer. Moreover, one example of forming an imaging layer over a semiconductor wafer is illustrated in Figure 2, wherein imaging layer 210 is formed over substrate 200.

In view of the foregoing, Applicant respectfully requests removal of the rejection to Claims 1-11 under 35 U.S.C. §112, second paragraph.

III. Claim Rejection under 35 U.S.C. §103.

The Office Action rejected Claims 1-11 under 35 U.S.C. §103 as being unpatentable over each of the following: IBM Technical Disclosure, volume 32, number 8A (Disclosure 1), and IBM Technical Disclosure, volume 33, number 3A (Disclosure 2). In response, Applicant submits that the presently amended Claims 1-11 would not have been obvious to one of ordinary skill in the art at the time that the present invention was made in view of either Disclosure 1 and/or Disclosure 2.

A. Disclosure 1

As presently amended, independent Claim 1 recites a lithography method:

> *"wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation."*

It is Applicant's understanding that Disclosure 1 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 1 does not teach, disclose, or suggest a first and second patterned layer forming a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation.

Furthermore, Claim 1, as presently amended, would not have been obvious in view of Disclosure 1 at the time the present was made because Disclosure 1 attempts to resolve a different problem than the problem resolved by the present invention. As the title of Disclosure 1 indicates, Disclosure 1 attempts to provide three sets of pattern information in two photomasking steps. Disclosure 1 is further applicable in applications which include creating three

different thicknesses of metallized patterns with one level of dielectric material. (page 219, lines 4-6).

In contrast, the present invention of Claim 1, forms a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. As these features are formed relatively closer to one another, the density with which semiconductor devices may be fabricated may be increased, allowing semiconductor devices to be fabricated with relatively smaller sizes.

In view of the foregoing, Applicant respectfully requests removal of the rejection to Claims 1 under 35 U.S.C. §103 in view of Disclosure 1. Given that Claims 2-11 depend upon independent Claim 1, and incorporate the features and limitation of Claim 1, Applicant respectfully requests removal of the rejection to Claims 2-11 under 35 U.S.C. §103 in view of Disclosure 1.

Additionally, Applicant submits that new claims 23 and 24 would not have been obvious to one of ordinary skill in the art at the time that the present invention was made in view of Disclosure 1.

New Claim 23 recites a lithography method:

> *"wherein the second patterned layer and the first patterned layer together form a single patterned layer of a plurality of disposable posts, each disposable post being formed relatively closer to other disposable posts than is possible through a single exposure to radiation."*

It is Applicant's understanding that Disclosure 1 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 1 does not teach, disclose, or suggest a first and second patterned layer together forming a single patterned layer of disposable posts, each disposable post being formed relatively

closer to other disposable posts than is possible through a single exposure to radiation.

Furthermore, new Claim 23 would not have been obvious in view of Disclosure 1 at the time the present was made because Disclosure 1 attempts to resolve a different problem than the present invention. As described above, Disclosure 1 provides three sets of pattern information in two photomasking steps. In contrast, the present invention, as claimed in new Claim 23, forms a single patterned layer of disposable posts which are formed relatively closer to one another than is possible through a single exposure to radiation, thus reducing semiconductor device sizes and increasing semiconductor device densities.

New Claim 24 recites a lithography method:

> *"wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features, the adjacent features having a pitch which is not limited by a single exposure to radiation."*

It is Applicant's understanding that Disclosure 1 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 1 does not teach, disclose, or suggest wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features, the adjacent features having a pitch which is not limited by a single exposure to radiation.

Furthermore, new Claim 24 would not have been obvious in view of Disclosure 1 at the time the present was made because Disclosure 1 attempts to resolve a different problem than the present invention. As described above, Disclosure 1 provides three sets of pattern information in two photomasking steps. In contrast, the present invention, as claimed in new Claim 24, forms a

single patterned layer having adjacent features having a pitch which is not limited by a single exposure to radiation, thus reducing semiconductor device sizes and increasing semiconductor device densities.

B. Disclosure 2

It is Applicant's understanding that Disclosure 2 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 2 does not teach, disclose, or suggest a first and second patterned layer forming a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation.

Furthermore, Claim 1, as presently amended, would not have been obvious in view of Disclosure 2 at the time the present was made because Disclosure 2 attempts to resolve a different problem than the problem resolved by the present invention. Disclosure 2 attempts to increase line capacity over that which is achievable with direct-write E-beam (DWEB) by splitting the critical levels into two complementary patterns, the first consisting of sub-0.5 micron images to be exposed by DWEB and the second (less critical) to be exposed optically. (page 62, paragraphs 1-3).

In contrast, the present invention of Claim 1, forms a single patterned layer having adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. As these features are formed relatively closer to one another, the density with which semiconductor devices may be fabricated may be increased, allowing semiconductor devices to be fabricated with relatively smaller sizes.

In view of the foregoing, Applicant respectfully requests removal of the rejection to Claims 1-11 under 35 U.S.C. §103 in view of Disclosure 2. Given that Claims 2-11 depend upon independent Claim 1, and incorporate the features and limitation of Claim 1, Applicant respectfully requests removal of the rejection to Claims 2-11 under 35 U.S.C. §103 in view of Disclosure 2.

Additionally, Applicant submits that new claims 23 and 24 would not have been obvious to one of ordinary skill in the art at the time that the present invention was made in view of Disclosure 2.

New Claim 23 recites a lithography method:

> *"wherein the second patterned layer and the first patterned layer together form a single patterned layer of a plurality of disposable posts, each disposable post being formed relatively closer to other disposable posts than is possible through a single exposure to radiation."*

It is Applicant's understanding that Disclosure 2 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 2 does not teach, disclose, or suggest a first and second patterned layer together forming a single patterned layer of disposable posts, each disposable post being formed relatively closer to other disposable posts than is possible through a single exposure to radiation.

Furthermore, new Claim 23 would not have been obvious in view of Disclosure 2 at the time the present was made because Disclosure 2 attempts to resolve a different problem than the present invention. As described above, Disclosure 2 attempts increase line capacity over that which is achievable with direct-write E-beam (DWEB) by splitting the critical levels into two complementary patterns, the first consisting of sub-0.5 micron images to be

exposed by DWEB and the second (less critical) to be exposed optically. (page 62, paragraphs 1-3). In contrast, the present invention, as claimed in new Claim 23, forms a single patterned layer of disposable posts which are formed relatively closer to one another than is possible through a single exposure to radiation, thus reducing semiconductor device sizes and increasing semiconductor device densities.

New Claim 24 recites a lithography method:

> *"wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features, the adjacent features having a pitch which is not limited by a single exposure to radiation."*

It is Applicant's understanding that Disclosure 2 fails to teach, disclose or suggest Applicant's invention as presently claimed. Disclosure 2 does not teach, disclose, or suggest wherein the second patterned layer and the first patterned layer form a single patterned layer having adjacent features, the adjacent features having a pitch which is not limited by a single exposure to radiation.

Furthermore, new Claim 24 would not have been obvious in view of Disclosure 2 at the time the present was made because Disclosure 2 attempts to resolve a different problem than the present invention. As described above, Disclosure 2 attempts increase line capacity over that which is achievable with direct-write E-beam (DWEB) by splitting the critical levels into two complementary patterns, the first consisting of sub-0.5 micron images to be exposed by DWEB and the second (less critical) to be exposed optically. (page 62, paragraphs 1-3). In contrast, the present invention, as claimed in new Claim 24, forms a single patterned layer having adjacent features having a pitch which is

not limited by a single exposure to radiation, thus reducing semiconductor device sizes and increasing semiconductor device densities.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 1-24 of the present Application are in consideration for allowance and reconsideration and allowance of the claims is respectfully solicited at the Examiner's earliest convenience.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: FEBRUARY 27, 1996

RBC

Roland B. Cortes
Reg. No. 39,152

12400 Wilshire Boulevard, Seventh Floor
Los Angeles, California 90025
(310) 207-3800

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on:

FEBRUARY 27, 1996

RBC 2-27-96

Name : Roland B. Cortes *Date*

$220.00 126 pp 1113

Attorney's Docket No. 016820.P048 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

James M. Cleeves

Application No.: 08/361,595

Filed: December 22,1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Unit: 1113

#10

Commissioner of Patents and Trademarks
Washington, D.C. 20231

INFORMATION DISCLOSURE STATEMENT

Sir:

Enclosed is a copy of Information Disclosure Citation Form PTO-1449 together with copies of the documents cited on that form. It is respectfully requested that the cited documents be considered and that the enclosed copy of Information Disclosure Citation Form PTO-1449 be initialed by the Examiner to indicate such consideration and a copy thereof returned to applicant.

Pursuant to 37 C.F.R. § 1.97, the submission of this Information Disclosure Statement is not to be construed as a representation that a search has been made and is not to be construed as an admission that the information cited in this statement is material to patentability.

Pursuant to 37 C.F.R. § 1.97, this Information Disclosure Statement is being submitted under one of the following (as indicated by an "X" to the left of the appropriate paragraph):

_____ 37 C.F.R. §1.97(b).

__X__ 37 C.F.R. §1.97(c). If so, then enclosed with this Information Disclosure Statement is one of the following:

____ A certification pursuant to 37 C.F.R. §1.97(e) or

__X__ A check for $ 220.00 for the fee under 37 C.F.R. § 1.17(p).

_____ 37 C.F.R. §1.97(d). If so, then enclosed with this Information Disclosure Statement are the following:

(1) A certification pursuant to 37 C.F.R. §1.97(e);

(2) A petition requesting consideration of the Information Disclosure Statement; and

(3) A check for $_____ for the fee under 37 C.F.R. §1.17(i) for submission of the Information Disclosure Statement.

If there are any additional charges, please charge Deposit Account No. 02-2666.

A duplicate copy of this Information Disclosure Statement is enclosed.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: March 26, 1996

RBC

Roland B. Cortes
Reg. No. 39,152

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, CA 90025-1026
(408)720-8598

FIRST CLASS CERTIFICATE OF MAILING
(37 C.F.R. § 1.8(a))

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231 on:
March 26, 1996
Date of Deposit

Dulcie G. Stinson March 26, 1996
Name: Dulcie G. Stinson Date

Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

ATTY. DOCKET NO.	SERIAL NO.
16820.P048	740145 ~~08/361,595~~

APPLICANT: James M. Cleeves

FILING DATE	GROUP
12/22/94	1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
KMD	AA	5 2 7 0 2 3 6	12/14/93	Rosner	437	48	
	AB	5 1 5 8 9 1 0	10/27/92	Cooper et al.	437	195	
	AC	5 2 1 9 7 8 7	06/18/93	Carey et al.	437	187	
	AD	5 3 1 9 2 4 7	06/07/94	Matsuura	257	760	
	AE	5 3 5 2 6 3 0	10/04/94	Kim et al.	437	195	
	AF	4 7 7 5 6 0 9	10/04/88	McFarland	430	325	
	AG	4 8 1 4 2 4 3	03/21/89	Ziger	430	30	
	AH	4 8 5 9 5 7 3	08/22/89	Maheras et al.	430	326	
↓	AI	4 9 8 5 3 7 4	01/15/91	Tsuji et al.	430	229	
KMD	AJ	5 3 2 0 9 3 2	06/14/94	Haraguchi et al.	430	312	
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

KMD	Fukase, et al, "A Margin-Free Contact Process Using An Al203 Etch-Stop Layer For High Density Devices", IEDM, April 1992, pp. 837-840.
KMD	Ueno, et al., "A High Quarter-Micron Planarized Interconnection Technology With Self-Aligned Plug", IEDM, April 1992, pp. 305-308.
KMD	Kusters, et al., "A High Density 4Mbit dRAM Process Using A Fully Overlapping Bitline Contact (FoBIC) Trench Cell", 1987 Symposium on VLSI Technology Digest of Technical Papers, May 18-21, 1987/Karuizawa, pp. 93-94.
KMD	Kakumu, et al., "PASPAC (Planarized A1/Silicide/Poly Si with Self Aligned Contact) with Low Contact Resistance and High Reliability in CMOS LSIs", 1987 Symposium on VLSI Technology Digest of Technical Papers, May 18-21, 1987/Karuizawa, pp. 77-78.

EXAMINER	DATE CONSIDERED
K. Duda	6-9-96

*EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Form PTO-1449 (REV. 8-83)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 16820.P048	SERIAL NO. 740145 ~~08/361,595~~
INFORMATION DISCLOSURE CITATION *(Use several sheets if necessary)*		APPLICANT James M. Cleeves	
		FILING DATE 12/22/94	GROUP 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA						
	AB						
	AC						
	AD						
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	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
	AL							
	AM							
	AN							
	AO							
	AP							

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

ICMD		Kenny, et al., "A Buried-Plate Trench Cell for a 64-Mb DRAM", 1992 Symposium on VLSI Technology Digest of Technical Papers, April 1992, pp. 14-15.
ICMD		Subbanna, et al., "A Novel Borderless Contact/Interconnect Technology Using Aluminum Oxide Etch Stop for High Performance SRAM and Logic", December 1993, pp. 441-444.
ICMD		Kusters, et al., "A Stacked Capacitor Cell with a Fully Self-Aligned Contact Process for High-Density Dynamic Random Access Memories", Journal of the Electrochemical Society, Vol. 139, No. 8, August 1992, pp. 2318-2321.
ICMD		"Method for Forming Via Hole Formation", IBM Technical Disclosure Bulletin, Vol. 34, No. 10A, March 1992, pp. 219-220.
ICMD		"Self-Aligned, Borderless Polysilicon Contacts Using Polysilicon Pillars", IBM Technical Disclosure Bulletin, Vol. 35, No. 2, July 1992, pp. 480-483.

EXAMINER	DATE CONSIDERED
ICMD	6-9-96

*EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

ATTY. DOCKET NO.	SERIAL NO.
16820.P048	740145 ~~08/361,595~~
APPLICANT	
James M. Cleeves	
FILING DATE	**GROUP**
12/22/94	1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	AA						
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FOREIGN PATENT DOCUMENTS

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	AL							
	AM							
	AN							
	AO							
	AP							

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

KMD		S. Wolf, Ph.D., et al., "Silicon Processing for the VLSI Era, Vol. I: Process Technology", Lithography I: Optical Resist Materials and Process Technology, 1986, pp. 453-454.
KMD		S. Wolf, Ph.D., "Silicon Processing for the VLSI Era, Vol 2: Process Integration", Multilevel-Interconnect Technology for VLSI & ULSI, 1992, pp. 222-237.

EXAMINER	DATE CONSIDERED
K Duda	6-9-96

*EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/361,595	12/22/94	CLEEVES, J	16820.P048

11M1/0610
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

DUDA, K EXAMINER	
ART UNIT	PAPER NUMBER
1113	11

DATE MAILED: 06/10/96

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

Office Action Summary

Application No.	Applicant(s)
08/361,595	Cleeves
Examiner	**Group Art Unit**
Kathleen Duda	1113

☒ Responsive to communication(s) filed on *Mar 4, 1996*.

☒ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *three* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) *1-24* is/are pending in the application.

Of the above, claim(s) *12-22* is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *1-11, 23, and 24* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). *10*

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

1. Claims 1-24 are pending in this application.

Election/Restriction

2. Claims 12-22 are withdrawn from further consideration by the examiner, 37 C.F.R. § 1.142(b) as being drawn to a nonelected invention. Election was made **without** traverse in Paper No. 6.

Response to Amendment

3. Applicant's arguments filed March 4, 1996 have been fully considered but they are not deemed to be persuasive.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

5. Claims 1-11, 23 and 24 are rejected under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 32, number 8A (Disclosure 1).

Disclosure 1 teaches a method of patterning. The method involves hardening a first photoresist image. A second layer of photoresist is then applied and openings formed which are coincident with the first. It would have been obvious to have formed an image as claimed with a stabilization of the first photoresist image before application of a second photoresist layer because Disclosure 1 teaches such with the second photoresist layer formed within openings of the first photoreisst image.

6. Claims 1-11, 23 and 24 are rejected under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 33, number 3A (Disclosure 2).

Disclosure 2 teaches a process for forming an image. The process involves applying a first resist layer to a substrate. The resist is exposed, developed and hardbaked to prevent reflow. An oxide layer is applied followed by a second resist layer. The second resist layer is exposed and developed and used in further processing of the substrate. It would have been obvious to one of skill in the art to have stabilized a first resist pattern before applying a second resist layer to be patterned because

Disclosure 2 teaches a process where the stabilization of the first image occurs before further resist processing.

7. Applicant has argued that the references do not teach that the first and second layer form a single patterned layer. Both teach that the layers are in contact with another and form a pattern which has portions from both layers. Two layers are used in both the references and the claimed invention so that there are two layers being formed.

Applicant has argued that the references solve a different problem. This is not found to be persuasive because the prior art does not have to accomplish the process for the same reasons.

Applicant has argued that the claimed invention recites disposable posts as the objects formed and the references do not teach this feature. Disposable posts are a design choice. The references teach a more generic formation.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 C.F.R. § 1.136(a).

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS FINAL ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS ACTION. IN THE EVENT A FIRST RESPONSE IS FILED WITHIN TWO MONTHS OF THE MAILING DATE OF THIS FINAL ACTION AND THE ADVISORY ACTION IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. § 1.136(a) WILL BE CALCULATED FROM THE

MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

9. Any inquiry concerning this communication should be directed to Examiner K. Duda at telephone number (703) 308-2292 or by FAX at (703) 305-3599. The receptionist can be reached at telephone number (703) 308-0661.

KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

kad
6-9-96

Interview Summary

Application No.	Applicant(s)
08/361,595	Cleeves
Examiner	**Group Art Unit**
Kathleen Duda	1113

All participants (applicant, applicant's representative, PTO personnel):

(1) *Kathleen Duda* (3) *Andrew Fortney*

(2) *Roland Cortes* (4) _____

Date of Interview *Sep 4, 1996*

Type: ☒ Telephonic ☐ Personal (copy is given to ☐ applicant ☐ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☒ No. If yes, brief description:

Agreement ☐ was reached. ☒ was not reached.

Claim(s) discussed: *1*

Identification of prior art discussed:
The two technical disclosures used in the art rejection in the final office action.

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:
Mr. Cortes and Mr. Fortney suggested amending the claims to recite that the first stablization step produces a first feature and the second stablization step produces a second feature and the relationship between the two. The art applied against the lcaims was discussed. The Examiner indicated that the amendments will be considered in regards to the art when presented but may require further consideration.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendents which would render the claims allowable is available, a summary thereof must be attached.)

1. ☒ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview unless box 1 above is also checked.

Examiner Note: You must sign and stamp this form unless it is an attachment to a signed Office action.

KATHLEEN DUDA
PRIMARY EXAMINER
ART UNIT 1113

Interview Summary

Application No.	Applicant(s)
08/361,595	Cleeves
Examiner	**Group Art Unit**
Kathleen Duda	1113

All participants (applicant, applicant's representative, PTO personnel):

(1) *Kathleen Duda* (3) *Andrew Fortney*

(2) *Roland Cortes* (4) _____

Date of Interview *Sep 4, 1996*

Type: ☒ Telephonic ☐ Personal (copy is given to ☐ applicant ☐ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☒ No. If yes, brief description:

Agreement ☐ was reached. ☒ was not reached.

Claim(s) discussed: *1*

Identification of prior art discussed:
The two technical disclosures used in the art rejection in the final office action.

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:
Mr. Cortes and Mr. Fortney suggested amending the claims to recite that the first stablization step produces a first feature and the second stablization step produces a second feature and the relationship between the two. The art applied against the lcaims was discussed. The Examiner indicated that the amendments will be considered in regards to the art when presented but may require further consideration.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendents which would render the claims allowable is available, a summary thereof must be attached.)

1. ☒ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview unless box 1 above is also checked.

KATHLEEN DUDA
PRIMARY EXAMINER
ART UNIT 1113

Examiner Note: You must sign and stamp this form unless it is an attachment to a signed Office action.

Attorney's Docket No.: 16820.P048

PATENT

In the Application of: James M. Cleeves
(inventors)

Appln. No: 08/361,595

Filed: 12/22/94

Amendment Under 37 C.F.R. § 1.116
EXPEDITED PROCEDURE
Examining Group: 1113

For: **Method For Reduced Pitch Lithography**
(title)

THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
BOX AF

SIR: Transmitted herewith is an **Amendment After Final Action** for the above application.

[ ] Small entity status of this application under 37 C.F.R. §§ 1.9 and 1.27 has been established by a verified statement previously submitted.

[ ] A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 is enclosed.

XXX No additional fee is required.

[ ] **A Notice of Appeal and Terminal Disclaimer under CFR 1.321(c) are enclosed.**

The fee has been calculated as shown below:

	(Col. 1) Claims remaining after amendment		(Col. 2) Highest no. previously paid for	(Col. 3) Present extra	Small Entity Rate	Small Entity Additional fee	Other than a Small Entity Rate	Other than a Small Entity Additional fee
Total Claims:	16	minus	20	0	x $11.00=	$0.00	x $22.00=	$0.00
Indep. Claims:	3	minus	3	0	x $39.00=	$0.00	x $78.00=	$0.00
[ ] First presentation of Multiple Dependent Claim(s)					+ $125.00	$0.00	+ $250.00	$0.00
**If the difference in Col.2 is less than zero, enter "0" in Col. 3					Total Add. Fee:	$0.00	Total Add. Fee:	$0.00

____ A check in the amount of **$0.00** is attached for presentation of additional claim(s).

XXX Applicant(s) hereby Petition(s) for an Extension of Time of **one** month(s) pursuant to 37 C.F.R. § 1.136(a).

XXX A check for **$110.00** is attached for processing fees under 37 C.F.R. § 1.17.

[ ] Please charge my Deposit Account No. 02-2666 the amount of _____ . **A duplicate copy of this sheet is enclosed.**

XXX The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 02-2666 (**a duplicate copy of this sheet is enclosed**).

XXX Any additional filing fees required under 37 C.F.R. § 1.16 for presentation of extra claims.

XXX Any extension of petition fees under 37 C.F.R. § 1.17.

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: SEPTEMBER 24, 1996

RBC

Roland B. Cortes
Reg. No. 39,152

12400 Wilshire Blvd., 7th Floor
Los Angeles, California 90025
(408) 720-8598

I hereby certify that this correspondence is being transmitted by facsimile to the U. S. Patent and Trademark Office in accordance with 37 C.F.R. § 1.6(d), on:

September 24, 1996

Dulcie G. Stinson 9/24/96

Dulcie G. Stinson *Date*

LJV/ccm (01/31/96)

110.-115 GP1113

Attorney Docket No.: 16820.P048

Patent

#12
10-7-96
KSpears

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED
OCT 5 1996
GROUP 1100

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: **METHOD FOR REDUCED PITCH LITHOGRAPHY**

Examiner: Duda, K.

Art Group: 1113

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commisioner of Patents and Trademarks, Washington, D.C. 20231

on 9/24/96
Date of Deposit
Dulce B. Stinson
Name of Person Mailing Correspondence
Dulce B. Stinson 9/24/96
Signature Date

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

PETITION FOR EXTENSION OF TIME
PURSUANT TO 37 C.F.R. § 1.136 (a)

Sir:

Applicant respectfully requests a one-month extension of time to file a Response to the Office Action mailed on June 10, 1996. The extended period expires on October 10, 1996.

A check in the amount of $110.00 is enclosed to cover the fee for a one-month extension of time. If any additional fee is required, please charge Deposit Account No. 02-2666. A duplicate of this Petition is enclosed for deposit account charging purposes.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: September 24, 1996

RBC

Roland B. Cortes
Reg. No. 9,152

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025-1026
(408) 720-8598

210 AG 10/03/96 08361595
1 115 110.00 CK

Attorney Docket No.: 16820.P048

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: **METHOD FOR REDUCED PITCH LITHOGRAPHY**

Examiner: Duda, K.

Art Group: 1113

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231

on 9/24/96
Date of Deposit

Dulce B. Stinson
Name of Person Mailing Correspondence

Dulce Stinson 9/24/96
Signature Date

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

PETITION FOR EXTENSION OF TIME
PURSUANT TO 37 C.F.R. § 1.136 (a)

Sir:

Applicant respectfully requests a one-month extension of time to file a Response to the Office Action mailed on June 10, 1996. The extended period expires on October 10, 1996.

A check in the amount of $110.00 is enclosed to cover the fee for a one-month extension of time. If any additional fee is required, please charge Deposit Account No. 02-2666. A duplicate of this Petition is enclosed for deposit account charging purposes.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: September 24, 1996

RBC

Roland B. Cortes
Reg. No. 9,152

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025-1026
(408) 720-8598

AF GP1113
#13CCMS)
10-7-96
KSP ecm

Attorney Docket No.: 16820.P048

Patent

AMENDMENT UNDER 37 C.F.R. § 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 1113

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Corres. and Mail
BOX AF

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Group: 1113

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

AMENDMENT AFTER FINAL ACTION UNDER 37 C.F.R. § 1.116

Sir:

In response to the Office Action, mailed June 10, 1996, which was made final, Applicant submits this Amendment After Final Action for consideration.

IN THE CLAIMS

Please amend claims 1, 23, and 24 as follows.

1. (Twice Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer having a first feature;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer having a second feature distinct from the first feature, wherein the second patterned layer and the first patterned layer form a single patterned layer [having adjacent], and wherein the first and second features which are formed relatively closer to one another than is possible through a single exposure to radiation.

23. (Once Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer having a first disposable post;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer having a second disposable post, wherein the second patterned layer and the first patterned layer together form a single patterned layer [of a plurality of disposable posts, each disposable post being], wherein the first and second disposable posts are formed relatively closer to [other disposable posts] one another than is possible through a single exposure to radiation.

24. (Once Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer having a first feature;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer <u>having a second feature</u>, wherein the second patterned layer and the first patterned layer form a single patterned layer [having adjacent features], the [adjacent] <u>first and second</u> features having a pitch which is not limited by a single exposure to radiation.

Please add new claims 25, 26, and 27.

25. (New) The lithography method of Claim 1, where the first and second features do not overlap.

26. (New) The lithography method of Claim 23, where the first and second features do not overlap.

27. (New) The lithography method of Claim 24, where the first and second features do not overlap.

REMARKS

Applicant respectfully requests that this Amendment After Final Action be admitted under 37 C.F.R. §1.116.

Applicant submits that this Amendment After Final Action presents claims in better form for consideration on appeal. Furthermore, Applicant believes that consideration of this amendment could lead to favorable action that would remove one or more issues for appeal.

Claims 1, 23, and 24 have been amended to better define the claimed invention. Support for the amendments to claims 1, 23, and 24 may be found, for example, at pages 5-14 and 23-25 of the specification and figures 1-5 as originally filed. No new matter has been added.

New claims 26-28 have been added. Support for new claims 26-28 may also be found, for example, at pages 5-14 and 23-25 of the specification and figures 1-5 as originally filed. No new matter has been added.

The rejection of claims 1-11, 23, and 24 under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 32, number 8A (Disclosure 1) is respectfully traversed.

Disclosure 1 discloses a method of incorporating three sets of pattern information in two photomasking steps. Figure 1 shows that holes A and B are formed in photoresist 2 through exposure and development process steps. Photoresist 2 is then hardened. Photoresist 6 is then applied and openings C and D are formed by exposure and development steps. Openings C and D overlap opening A. Figures 2 and 3 show the creation of opening E by further processing steps.

Disclosure 1 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature. As previously discussed, Disclosure 1 forms overlapping

openings A, C, D, and E in order to incorporate three sets of patterns in two photomasking steps. Thus, Disclosure 1 teaches away from amended claim 1, because openings A, C, D, and E are overlapping non-distinct features.

Furthermore, Disclosure 1 does not suggest first and second features formed relatively closer to one another than is possible through a single exposure to radiation, as achieved in the present invention, because Disclosure 1 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature. There is no teaching in Disclosure 1 to motivate one of ordinary skill in the art to perform a subsequent patterning of photoresist 6 to form a second distinct feature which is relatively closer to openings A or B than is possible through a single exposure to radiation. Furthermore, there is no teaching in Disclosure 1 that openings C, D, or E are formed relatively closer to opening B than is possible in a single exposure to radiation.

As indicated by the specification at pages 23-25, given that the first and second features are formed relatively closer to one another than is possible in a single exposure to radiation, the density with which semiconductor devices may be fabricated may be increased. As a result, next generation densities can be achieved using current generation technologies. Therefore, the present invention is not obvious in view of Disclosure 1.

Consequently, the rejection of claims 1-11, 23, 24 is unsustainable and should be withdrawn.

The rejection of claims 1-11, 23, and 24 under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 3, number 3A (Disclosure 2) is respectfully traversed.

Disclosure 2 discloses a method of writing patterns on a semiconductor wafer that increases line capacity over that which is achievable using only direct-

write E-beam (DWEB) technology. Disclosure 2 accomplishes the increased line capacity by optically exposing images larger than 0.5 μm in a first resist layer, and then DWEB exposing smaller images in a second resist layer.

Disclosure 2 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature that is formed relatively closer to the first feature than is possible through a single exposure to radiation. Moreover, one of ordinary skill in the art would not have been motivated to modify the disclosure of Disclosure 2 to achieve the claimed invention, because Disclosure 2 attempts to increase the line capacity of writing images, and does not attempt to create features or images which are relatively closer to one another than is possible in a single exposure to radiation. Any such reading into Disclosure 2 would be impermissible hindsight based on Applicant's disclosure.

As indicated by the specification at pages 23-25, given that the first and second features are formed relatively closer to one another than is possible in a single exposure to radiation, the density with which semiconductor devices may be fabricated may be increased. As a result, next generation densities can be achieved using current generation technologies. Therefore, the present invention is not obvious in view of Disclosure 2.

Consequently, the rejection of claims 1-11, 23, and 24 is unsustainable and should be withdrawn.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 1-11, and 23-27 of the present Application are in consideration for allowance and reconsideration and allowance of the claims is respectfully solicited at the Examiner's earliest convenience.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: September 24, 1996

RBC

Roland B. Cortes
Reg. No. 39,152

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025
(408) 720-8598

FIRST CLASS CERTIFICATE OF MAILING
(37 C.F.R. § 1.8(a))

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231 on 09/24/96.

Date of Deposit

Dulcie G. Stinson

Name of Person Mailing Correspondence

Dulcie G. Stinson

Signature

9/24/96

Date

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/361,595	12/22/94	CLEEVES J	16820.P048

DUDA,K EXAMINER

11M1/1015

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

ART UNIT	PAPER NUMBER
1113	14

DATE MAILED: 10/15/96

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Advisory Action

Application No.	Applicant(s)
08/361,595	Cleeves
Examiner	**Group Art Unit**
Kathleen Duda	1113

THE PERIOD FOR RESPONSE: [check only a) or b)]

a) ☒ expires *four* months from the mailing date of the final rejection.

b) ☐ expires either three months from the mailing date of the final rejection, or on the mailing date of this Advisory Action, whichever is later. In no event, however, will the statutory period for the response expire later than six months from the date of the final rejection.

Any extension of time must be obtained by filing a petition under 37 CFR 1.136(a), the proposed response and the appropriate fee. The date on which the response, the petition, and the fee have been filed is the date of the response and also the date for the purposes of determining the period of extension and the corresponding amount of the fee. Any extension fee pursuant to 37 CFR 1.17 will be calculated from the date of the originally set shortened statutory period for response or as set forth in b) above.

☐ Appellant's Brief is due two months from the date of the Notice of Appeal filed on _____ (or within any period for response set forth above, whichever is later). See 37 CFR 1.191(d) and 37 CFR 1.192(a).

Applicant's response to the final rejection, filed on *Sep 30, 1996* **has been considered with the following effect, but is NOT deemed to place the application in condition for allowance:**

☒ The proposed amendment(s):

☐ will be entered upon filing of a Notice of Appeal and an Appeal Brief.

☒ will not be entered because:

☒ they raise new issues that would require further consideration and/or search. (See note below).

☐ they raise the issue of new matter. (See note below).

☐ they are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal.

☒ they present additional claims without cancelling a corresponding number of finally rejected claims.

NOTE: *The new claims raise new issues which require further consideration and possibly further search.*

☐ Applicant's response has overcome the following rejection(s):

☐ Newly proposed or amended claims _____ would be allowable if submitted in a separate, timely filed amendment cancelling the non-allowable claims.

☐ The affidavit, exhibit or request for reconsideration has been considered but does NOT place the application in condition for allowance because:

☐ The affidavit or exhibit will NOT be considered because it is not directed SOLELY to issues which were newly raised by the Examiner in the final rejection.

☒ For purposes of Appeal, the status of the claims is as follows (see attached written explanation, if any):

Claims allowed: *none*

Claims objected to: *none*

Claims rejected: *1-11, 23 and 24 (claims 12-22 are nonelected)*

☐ The proposed drawing correction filed on _____ ☐ has ☐ has not been approved by the Examiner.

☐ Note the attached Information Disclosure Statement(s), PTO-1449, Paper No(s). _____ .

☐ Other

KDuda

KATHLEEN DUDA
PRIMARY EXAMINER
ART UNIT 1113

EXTENSION OF TIME ONLY #15/Ext. of Time

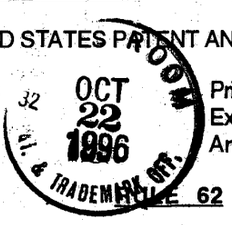
Attorney's Docket No. 16820.P048

Patent 2 mos.

M. Watts 11/5/96

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX FWC



Prior Application: 08/361,595
Examiner: Duda, K.
Art Unit: 1113

RECEIVED
OCT 31 1996
GROUP 1100

Sir: This is a request for filing a **file wrapper**

XX Continuation application ____ Divisional application

under 37 C.F.R. § 1.62 of pending prior nonprovisional application no. 08/361,595,

filed on December 22, 1994,

of James M. Cleeves,

(inventor(s) currently of record for prior application)

for METHOD FOR REDUCED PITCH LITHOGRAPHY.

(title)

X 1. **The above-identified prior application is hereby expressly abandoned under 37 C.F.R. § 1.62(g) as of the filing date of this new application. Please use all the contents of the prior application file wrapper, including the drawings, as the basic papers for the new application. No such copy of the prior application is included herewith. The present application is being filed under 37 C.F.R. § 1.62 before the payment of the issue fee, abandonment of, or termination of the proceedings on the prior application, or after payment of the issue fee (the latter if a petition under 37 C.F.R. § 1.313(b)(5) has been filed and granted in the prior application).**

____ 2. Please enter the preliminary amendment enclosed before calculating the filing fee.

X 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on **September 30, 1996** under 37 C.F.R. § 1.116, but unentered, in the parent application.

"Express Mail" mailing label number EM531594546US

Date of Deposit October 22, 1996

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Anne Gemetzke
(Typed or printed name of person mailing paper or fee)

Anne Gemetzke 10/22/96
(Signature of person mailing paper or fee)

LJV/cak (10/01/96) Rule 62

380 MM 10/28/96 08361595
1 116 390.00 CK

FOR GD

_____ 4. Cancel in this application claims _____ of the prior application before calculating the filing fee (wherein at least one independent claim is retained for filing purposes).

__X__ 5. The filing fee is calculated below:

CLAIMS NOW PENDING IN THE PRIOR APPLICATION PLUS/MINUS CLAIMS ADDED/CANCELED ABOVE

	(Col. 1)		(Col. 2)	SMALL ENTITY		OTHER THAN A SMALL ENTITY	
For:	No. Filed		No. Extra	Rate	Fee	Rate	Fee
Basic Fee:					$ 385		$ 770
Total Claims:	16	- 20	* 0	x 11	$	x 22	$ 0
Indep. Claims:	3	- 3	* 0	x 40	$	x 80	$ 0
[ ] Multiple Dependent Claim(s) Presented				+130	$	+260	$
* If the difference is less than zero, enter "0" in Col. 2.				TOTAL	$	TOTAL	$ 770

_____ 6. A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 _____ is enclosed/_____ was filed in the pending prior application **and such status is still proper and desired.** 37 C.F.R. § 1.28(a).

__X__ 7. The Assistant Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment, to Deposit Account No. 02-2666. A duplicate of this sheet is enclosed for Deposit Account purposes.

__X__ 8. A check in the amount of $ 770.00 is enclosed for the filing fee.

__X__ 9. A check in the amount of $ 390.00 is enclosed for the petition fee pursuant to 37 C.F.R. § 1.17.

__X__ 10. Amend the specification by inserting the following before the first sentence on the first page:

__X__ (a) – This is a __X__ continuation/_____ divisional of application no. 08/361,595, filed 12/22/94, now abandoned. --

_____ (b) –, which is a _____ continuation/_____ divisional of application no._____, filed_____

_____

_____. -- (Status: abandoned, pending, etc.)

(list all prior applications)

__X__ 11. It is hereby requested that any request for a convention priority made in the prior application be transferred to this Rule 62 application.

_____ 12. Priority of foreign application number _____ filed on _____ in (country) _____ is claimed under 35 U.S.C. § 119.

_X_ 13. The prior application is assigned of record to:
Cypress Semiconductor Corporation
3901 North First Street, San Jose, CA 95134.

_X_ 14. The Power of Attorney in the prior application is to:
James C. Scheller, Jr. 31,195,
(Name) (Reg. No.)
Edwin H Taylor, Reg. No. 25,129, and certain other listed attorneys or agent(s) of:
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(310) 207-3800

_X_ (a) The Power appears in the original papers of the prior application no. 08/361,595 filed 12/22/94.

_____ (b) The Power does not appear in the original papers, but was filed on _____ in prior application no. _____ filed _____.

_____ (c) A new Power has been executed and is attached.

_X_ (d) Recognize as an associate attorney or agent and address all future communications to:
Roland B. Cortes 39,152,
(Name) (Reg. No.)
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(408) 720-8598

_X_ (e) Address all future communications to the undersigned.

_____ 15. **Enclosed is a photocopy of a petition for an extension of time pursuant to 37 C.F.R. § 1.136 concurrently (or previously) submitted under separate cover for the above-referenced prior application.**

_X_ 16. Applicant(s) hereby petition(s) for an extension of time pursuant to 37 C.F.R. § 1.136, if needed, for the above-noted prior application. The Assistant Commissioner is hereby authorized to charge any extension or petition fee under 37 C.F.R. § 1.17 that may be required for the above-referenced prior application to Deposit Account No. 02-2666. Two photocopies of this document are enclosed for filing in the prior application file and for Deposit Account purposes.

_X_ 17. The filing of an application under 37 C.F.R § 1.62 will be construed to include a waiver of secrecy under 35 U.S.C. § 122 to the extent that any member of the public who is entitled under the provisions of 37 C.F.R. § 1.14 to access to or information

concerning either the prior application or any continuing application filed under the provisions of 37 C.F.R. § 1.62 may be given similar access to, or similar information concerning, the other application(s) in the file wrapper.
37 C.F.R. § 1.62(f).

_____ 18. This application is being filed by fewer than all the inventors named in the prior application. In accordance with 37 C.F.R. § 1.62(a), the Assistant Commissioner is requested to delete the name(s) of the following person(s) who are not inventors of invention being claimed in this application:

_____

_____.

Respectfully submitted,

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

Date: 10/22/96

By RBCA
Roland B. Cortes

Reg. No. 39,152

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(408) 720-8598

_____ Attorney or Agent of Record

__X__ Associate Attorney or Agent

_____ Filed Under 37 C.F.R. § 1.34(a)

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/361,595	12/22/94	CLEEVES	16630.P148

11M1/1218

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
7TH FLOOR
LOS ANGELES CA 90025

EXAMINER	
DUDA, K.	
ART UNIT	PAPER NUMBER
1113	16

DATE MAILED: 12/18/96

NOTICE OF ABANDONMENT

This application is abandoned in view of:

1. ☒ Applicant's failure to respond to the Office letter, mailed 6-10-96.
2. ☐ Applicant's letter of express abandonment which is in compliance with 37 C.F.R. 1.138.
3. ☐ Applicant's failure to timely file the response received _____ within the period set in the Office letter.
4. ☐ Applicant's failure to pay the required issue fee within the statutory period of 3 months from the mailing date of _____ of the Notice of Allowance.
   - ☐ The issue fee was received on _____.
   - ☐ The issue fee has not been received in Allowed Files Branch as of _____.

   In accordance with 35 U.S.C. 151, and under the provisions of 37 C.F.R. 1.316(b), applicant(s) may petition the Commissioner to accept the delayed payment of the issue fee if the delay in payment was unavoidable. The petition must be accompanied by the issue fee, unless it has been previously submitted, in the amount specified by 37 C.F.R. 1.17(l), and a verified showing as to the causes of the delay.

   If applicant(s) never received the Notice of Allowance, a petition for a new Notice of Allowance and withdrawal of the holding of abandonment may be appropriate in view of Delgar Inc. v. Schuyler, 172 U.S.P.Q. 513.
5. ☐ Applicant's failure to timely correct the drawings and/or submit new or substitute formal drawings by _____ as required in the last Office action.
   ☐ The corrected and/or substitute drawings were received on _____.
6. ☐ The reason(s) below.

K Duda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

PTO-1432 (Rev. 4/93)

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

350 SC 11/12/96 08740145
1 101 770.00 CK 16820.P048

PTO-1556
(5/87)

BAR CODE LABEL

U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/740,145	10/22/96	430	1113

APPLICANT

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA********
VERIFIED THIS APPLN IS A CON OF 08/361,595 12/22/94

FOREIGN/PCT APPLICATIONS********
VERIFIED

FOREIGN FILING LICENSE GRANTED 11/18/96

STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS	FILING FEE RECEIVED	ATTORNEY DOCKET NO.
CA	10	16	3	$770.00	16820.P048

ADDRESS

BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES CA 90025

TITLE

METHOD FOR REDUCED PITCH LITHOGRAPHY

This is to certify that annexed hereto is a true copy from the records of the United States Patent and Trademark Office of the application which is identified above.

By authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

Date Certifying Officer

AF 6PA13

Attorney Docket No.: 16820.P048

Patent

OCT 22 Page

AMENDMENT UNDER 37 C.F.R. § 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 1113

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Corres. and Mail
BOX AF

In re Application of:

James M. Cleeves

Serial No.: 08/361,595

Filed: December 22, 1994

For: **METHOD FOR REDUCED PITCH LITHOGRAPHY**

Examiner: Duda, K.

Art Group: 1113

Honorable Commissioner
of Patents and Trademarks
Washington, DC 20231-9998

AMENDMENT AFTER FINAL ACTION UNDER 37 C.F.R. § 1.116

Sir:

In response to the Office Action, mailed June 10, 1996, which was made final, Applicant submits this Amendment After Final Action for consideration.

IN THE CLAIMS

Please amend claims 1, 23, and 24 as follows.

1. (Twice Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer having a first feature;

(c) stabilizing the first patterned layer;

720 VB 02-2666 10/09/96 08361595

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer <u>having a second feature distinct from the first feature,</u> wherein the second patterned layer and the first patterned layer form a single patterned layer [having adjacent]<u>, and wherein the first and second</u> features which are formed relatively closer to one another than is possible through a single exposure to radiation.

~~23~~. (Once Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer <u>having a first disposable post</u>;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer <u>having a second disposable post</u>, wherein the second patterned layer and the first patterned layer together form a single patterned layer [of a plurality of disposable posts, each disposable post being]<u>, wherein the first and second disposable posts are</u> formed relatively closer to [other disposable posts] <u>one another</u> than is possible through a single exposure to radiation.

~~24~~. (Once Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of:

(a) forming a first imaging layer over the semiconductor wafer;

(b) patterning the first imaging layer in accordance with a first pattern to form a first patterned layer <u>having a first feature</u>;

(c) stabilizing the first patterned layer;

(d) forming a second imaging layer over the first patterned layer; and

(e) patterning the second imaging layer in accordance with a second pattern to form a second patterned layer having a second feature, wherein the second patterned layer and the first patterned layer form a single patterned layer [having adjacent features], the [adjacent] first and second features having a pitch which is not limited by a single exposure to radiation.

Please add new claims 25, 26, and 27.

~~25.~~ 13 (New) The lithography method of Claim 1, where the first and second features do not overlap.

~~26.~~ 14 (New) The lithography method of Claim ~~25~~ 13, where the first and second features do not overlap.

~~27.~~ 16 (New) The lithography method of Claim ~~24~~ 15, where the first and second features do not overlap.

REMARKS

Applicant respectfully requests that this Amendment After Final Action be admitted under 37 C.F.R. §1.116.

Applicant submits that this Amendment After Final Action presents claims in better form for consideration on appeal. Furthermore, Applicant believes that consideration of this amendment could lead to favorable action that would remove one or more issues for appeal.

Claims 1, 23, and 24 have been amended to better define the claimed invention. Support for the amendments to claims 1, 23, and 24 may be found, for example, at pages 5-14 and 23-25 of the specification and figures 1-5 as originally filed. No new matter has been added.

New claims 26-28 have been added. Support for new claims 26-28 may also be found, for example, at pages 5-14 and 23-25 of the specification and figures 1-5 as originally filed. No new matter has been added.

The rejection of claims 1-11, 23, and 24 under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 32, number 8A (Disclosure 1) is respectfully traversed.

Disclosure 1 discloses a method of incorporating three sets of pattern information in two photomasking steps. Figure 1 shows that holes A and B are formed in photoresist 2 through exposure and development process steps. Photoresist 2 is then hardened. Photoresist 6 is then applied and openings C and D are formed by exposure and development steps. Openings C and D overlap opening A. Figures 2 and 3 show the creation of opening E by further processing steps.

Disclosure 1 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature. As previously discussed, Disclosure 1 forms overlapping

openings A, C, D, and E in order to incorporate three sets of patterns in two photomasking steps. Thus, Disclosure 1 teaches away from amended claim 1, because openings A, C, D, and E are overlapping non-distinct features.

Furthermore, Disclosure 1 does not suggest first and second features formed relatively closer to one another than is possible through a single exposure to radiation, as achieved in the present invention, because Disclosure 1 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature. There is no teaching in Disclosure 1 to motivate one of ordinary skill in the art to perform a subsequent patterning of photoresist 6 to form a second distinct feature which is relatively closer to openings A or B than is possible through a single exposure to radiation. Furthermore, there is no teaching in Disclosure 1 that openings C, D, or E are formed relatively closer to opening B than is possible in a single exposure to radiation.

As indicated by the specification at pages 23-25, given that the first and second features are formed relatively closer to one another than is possible in a single exposure to radiation, the density with which semiconductor devices may be fabricated may be increased. As a result, next generation densities can be achieved using current generation technologies. Therefore, the present invention is not obvious in view of Disclosure 1.

Consequently, the rejection of claims 1-11, 23, 24 is unsustainable and should be withdrawn.

The rejection of claims 1-11, 23, and 24 under 35 U.S.C. § 103 as being unpatentable over IBM Technical Disclosure, volume 3, number 3A (Disclosure 2) is respectfully traversed.

Disclosure 2 discloses a method of writing patterns on a semiconductor wafer that increases line capacity over that which is achievable using only direct-

write E-beam (DWEB) technology. Disclosure 2 accomplishes the increased line capacity by optically exposing images larger than 0.5 μm in a first resist layer, and then DWEB exposing smaller images in a second resist layer.

Disclosure 2 does not disclose exposing a portion of a first imaging layer to form a first feature and subsequently patterning a second imaging layer to form a second distinct feature that is formed relatively closer to the first feature than is possible through a single exposure to radiation. Moreover, one of ordinary skill in the art would not have been motivated to modify the disclosure of Disclosure 2 to achieve the claimed invention, because Disclosure 2 attempts to increase the line capacity of writing images, and does not attempt to create features or images which are relatively closer to one another than is possible in a single exposure to radiation. Any such reading into Disclosure 2 would be impermissible hindsight based on Applicant's disclosure.

As indicated by the specification at pages 23-25, given that the first and second features are formed relatively closer to one another than is possible in a single exposure to radiation, the density with which semiconductor devices may be fabricated may be increased. As a result, next generation densities can be achieved using current generation technologies. Therefore, the present invention is not obvious in view of Disclosure 2.

Consequently, the rejection of claims 1-11, 23, and 24 is unsustainable and should be withdrawn.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 1-11, and 23-27 of the present Application are in consideration for allowance and reconsideration and allowance of the claims is respectfully solicited at the Examiner's earliest convenience.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: SEPTEMBER 24, 1996

RBC

Roland B. Cortes
Reg. No. 39,152

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025
(408) 720-8598

FIRST CLASS CERTIFICATE OF MAILING
(37 C.F.R. § 1.8(a))

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231 on 09/24/96
Date of Deposit

Dulcie G. Stinson
Name of Person Mailing Correspondence

Dulcie G. Stinson
Signature

9/24/96
Date

Attorney's Docket No. 16820.P048

FWC

Patent

#181

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX FWC

Prior Application: 08/361,595
Examiner: Duda, K.
Art Unit: 1113

RULE 62

Sir: This is a request for filing a **file wrapper**

__XX__ Continuation application _____ Divisional application

under 37 C.F.R. § 1.62 of pending prior nonprovisional application no. 08/361,595,

filed on December 22, 1994,

of James M. Cleeves,
(inventor(s) currently of record for prior application)

for METHOD FOR REDUCED PITCH LITHOGRAPHY.
(title)

__X__ 1. **The above-identified prior application is hereby expressly abandoned under 37 C.F.R. § 1.62(g) as of the filing date of this new application. Please use all the contents of the prior application file wrapper, including the drawings, as the basic papers for the new application. No such copy of the prior application is included herewith. The present application is being filed under 37 C.F.R. § 1.62 before the payment of the issue fee, abandonment of, or termination of the proceedings on the prior application, or after payment of the issue fee (the latter if a petition under 37 C.F.R. § 1.313(b)(5) has been filed and granted in the prior application).**

_____ 2. Please enter the preliminary amendment enclosed before calculating the filing fee.

__X__ 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on **September 30, 1996** under 37 C.F.R. § 1.116, but unentered, in the parent application.

"Express Mail" mailing label number EM531594546US

Date of Deposit October 22, 1996

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Anne Gernetzke
(Typed or printed name of person mailing paper or fee)

Anne Gernetzke 10/22/96
(Signature of person mailing paper or fee)

LJV/cak (10/01/96) Rule 62

E

_____ 4. Cancel in this application claims _____ of the prior application before calculating the filing fee (wherein at least one independent claim is retained for filing purposes).

__X__ 5. The filing fee is calculated below:

CLAIMS NOW PENDING IN THE PRIOR APPLICATION PLUS/MINUS CLAIMS ADDED/CANCELED ABOVE

	(Col. 1)		(Col. 2)	SMALL ENTITY		OTHER THAN A SMALL ENTITY	
For:	No. Filed		No. Extra	Rate	Fee	Rate	Fee
Basic Fee:					$ 385		$ 770
Total Claims:	16	- 20	* 0	x 11	$	x 22	$ 0
Indep. Claims:	3	- 3	* 0	x 40	$	x 80	$ 0
☐	**Multiple Dependent Claim(s) Presented**			**+130**	$	**+260**	$
				TOTAL	$	TOTAL	$ 770

* If the difference is less than zero, enter "0" in Col. 2.

_____ 6. A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 _____ is enclosed/_____ was filed in the pending prior application **and such status is still proper and desired.** 37 C.F.R. § 1.28(a).

__X__ 7. The Assistant Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment, to Deposit Account No. 02-2666. A duplicate of this sheet is enclosed for Deposit Account purposes.

__X__ 8. A check in the amount of $ 770.00 is enclosed for the filing fee.

__X__ 9. A check in the amount of $ 390.00 is enclosed for the petition fee pursuant to 37 C.F.R. § 1.17.

__X__ 10. Amend the specification by inserting the following before the first sentence on the first page:

E1

__X__ (a) – This is a __X__ continuation/_____ divisional of application no. 08/361,595, filed 12/22/94, now abandoned. --

_____ (b) –, which is a _____ continuation/_____ divisional of application no. _____, filed _____

_____

_____. -- (Status: abandoned, pending, etc.)

(list all prior applications)

__X__ 11. It is hereby requested that any request for a convention priority made in the prior application be transferred to this Rule 62 application.

LJV/cak (10/01/96) Rule 62

35

_____ 12. Priority of foreign application number _____ filed on _____ in (country) _____ is claimed under 35 U.S.C. § 119.

_X_ 13. The prior application is assigned of record to:
Cypress Semiconductor Corporation
3901 North First Street, San Jose, CA 95134.

_X_ 14. The Power of Attorney in the prior application is to:
James C. Scheller, Jr. (Name) 31,195 (Reg. No.),
Edwin H Taylor, Reg. No. 25,129, and certain other listed attorneys or agent(s) of:
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(310) 207-3800

_X_ (a) The Power appears in the original papers of the prior application no. 08/361,595 filed 12/22/94.

_____ (b) The Power does not appear in the original papers, but was filed on _____ in prior application no. _____ filed _____.

_____ (c) A new Power has been executed and is attached.

_X_ (d) Recognize as an associate attorney or agent and address all future communications to:
Roland B. Cortes (Name) 39,152 (Reg. No.),
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(408) 720-8598

_X_ (e) Address all future communications to the undersigned.

_____ **15. Enclosed is a photocopy of a petition for an extension of time pursuant to 37 C.F.R. § 1.136 concurrently (or previously) submitted under separate cover for the above-referenced prior application.**

_X_ 16. Applicant(s) hereby petition(s) for an extension of time pursuant to 37 C.F.R. § 1.136, if needed, for the above-noted prior application. The Assistant Commissioner is hereby authorized to charge any extension or petition fee under 37 C.F.R. § 1.17 that may be required for the above-referenced prior application to Deposit Account No. 02-2666. Two photocopies of this document are enclosed for filing in the prior application file and for Deposit Account purposes.

_X_ 17. The filing of an application under 37 C.F.R § 1.62 will be construed to include a waiver of secrecy under 35 U.S.C. § 122 to the extent that any member of the public who is entitled under the provisions of 37 C.F.R. § 1.14 to access to or information

concerning either the prior application or any continuing application filed under the provisions of 37 C.F.R. § 1.62 may be given similar access to, or similar information concerning, the other application(s) in the file wrapper.
37 C.F.R. § 1.62(f).

______ 18. This application is being filed by fewer than all the inventors named in the prior application. In accordance with 37 C.F.R. § 1.62(a), the Assistant Commissioner is requested to delete the name(s) of the following person(s) who are not inventors of invention being claimed in this application:

____

____.

Respectfully submitted,

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

Date: 10/02/96

By RBC

Roland B. Cortes

Reg. No. 39,152

12400 Wilshire Boulevard
~~Seventh Floor~~
Los Angeles, California 90025
(408) 720-8598

______ Attorney or Agent of Record

__X__ Associate Attorney or Agent

______ Filed Under 37 C.F.R. § 1.34(a)

08/724,025

Notice of Allowability	Application No. 08/740,145	Applicant(s) Cleeves
	Examiner Kathleen Duda	Group Art Unit 1113

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course.

☐ This communication is responsive to _____.

☒ The allowed claim(s) is/are *1-11 and 23-27*.

☐ The drawings filed on _____ are acceptable.

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE **THREE MONTHS** FROM THE "DATE MAILED" of this Office action. Failure to timely comply will result in ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

☒ Applicant MUST submit NEW FORMAL DRAWINGS

☐ because the originally filed drawings were declared by applicant to be informal.

☒ including changes required by the Notice of Draftsperson's Patent Drawing Review, PTO-948, attached hereto or to Paper No. *4*.

☐ including changes required by the proposed drawing correction filed on _____, which has been approved by the examiner.

☐ including changes required by the attached Examiner's Amendment/Comment.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the reverse side of the drawings. The drawings should be filed as a separate paper with a transmittal lettter addressed to the Official Draftsperson.

☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any response to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE/SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

☐ Interview Summary, PTO-413

☒ Examiner's Amendment/Comment

☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

☒ Examiner's Statement of Reasons for Allowance

Serial Number: 08/740,145
Art Unit: 1113

Part III EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

2. The application has been amended as follows:

Cancel claims 12-22.

Claims 12-22 were nonelected without traverse in paper number 6.

3. The following is an examiner's statement of reasons for allowance:

Claims 1-11 and 23-27 have been found to be allowable over the prior art of record. The claimed invention is drawn to a process of forming a semiconductor by forming a first pattern in a first layer and stabilizing that layer before applying a second patterning layer. A pattern is then formed in the second layer with a second feature distinct from the feature in the first layer with the two features being formed closer to one another than possible in a single exposure. Disclosure 1 does not teach the formation of two distinct features in the two layers. Disclosure 2 forms two distinct patterns in two different layers

but the patterns are not formed closer to one another than possible in a single exposure. Rather images are forme din one layer using one method which produces a certain resolution and then a second pattern is formed in the second layer where resolution is less critical.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

4. Any inquiry concerning this communication should be directed to Examiner K. Duda at telephone number (703) 308-2292 or by FAX at (703) 305-3599.

K Duda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

kad
2-10-97

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: Box ISSUE FEE
ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

11M1/0212

BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES CA 90025

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT		DATE MAILED
08/740,145	10/22/96	016	DUDA, K	1113	02/12/97
First Named Applicant	CLEEVES,	JAMES M.			

TITLE OF INVENTION: METHOD FOR REDUCED PITCH LITHOGRAPHY

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
1 16820.P048	430-315.000	J48	UTILITY	NO	$1290.00	05/12/97

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.
If the SMALL ENTITY is shown as yes, verify your current SMALL ENTITY status:

A. If the status is changed, pay twice the amount of the FEE DUE shown and notify the Patent and Trademark Office of the change in status, or
B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

A. Pay FEE DUE shown above, or

B. File verified statementof Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B of this notice should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "6b" of Part B should be completed.

III. All communications regarding this application must give application number and batch number. Please direct all communication prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

3. PATENT AND TRADEMARK OFFICE COPY

PTOL-85 (REV. 05-96)(0651-0033)

*U.S. GPO: 1996-404-496/40511

Attorney's Docket No.: 16820.P048C

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
James M. Cleeves

Application No.: 08/740,145

Filing Date: October 22, 1996

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

A Continuation of:

Application No.: 08/361,595

Filing Date: December 22, 1994

Examiner: Duda, K.

Art Unit: 1113

Batch No.: J48

BOX ISSUE FEE
Assistant Commissioner for Patents
Washington, D.C. 20231

PAYMENT OF ISSUE FEE AND SUBMISSION OF FORMAL DRAWINGS

Sir:

In response to the Notice of Allowance mailed February 12, 1997 enclosed herewith for filing in the above-referenced patent application are ten (10) sheets of formal drawings.

Also enclosed is a check in the amount of $1,320.00 for payment of the issue fee of $1,290.00 and the Advanced Order fee of $30.00.

If any additional fee is required, please charge Deposit Account No. 02-2666. A duplicate of this Submission is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 4/4, 1997

Tarek N. Fahmi
Reg. No. P-41,402

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, CA 90025-1026
(408) 720-8598

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231
on April 4, 1997
Date of Deposit
Patricia A. Balero
Name of Person Mailing Correspondence
Signature
04/04/97
Date

Attorney's Docket No.: 16820.P048C Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
James M. Cleeves

Application No.: 08/740,145

Filing Date: October 22, 1996

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

A Continuation of:

Application No.: 08/361,595

Filing Date: December 22, 1994

Examiner: Duda, K.

Art Unit: 1113

Batch No.: J48

BOX ISSUE FEE
Assistant Commissioner for Patents
Washington, D.C. 20231

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Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 4/4, 1997

Tarek N. Fahmi
Reg. No. P-41,402

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, CA 90025-1026
(408) 720-8598

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231
on April 4, 1997
Date of Deposit
Patricia A. Balero
Name of Person Mailing Correspondence
Signature
04/04/97
Date

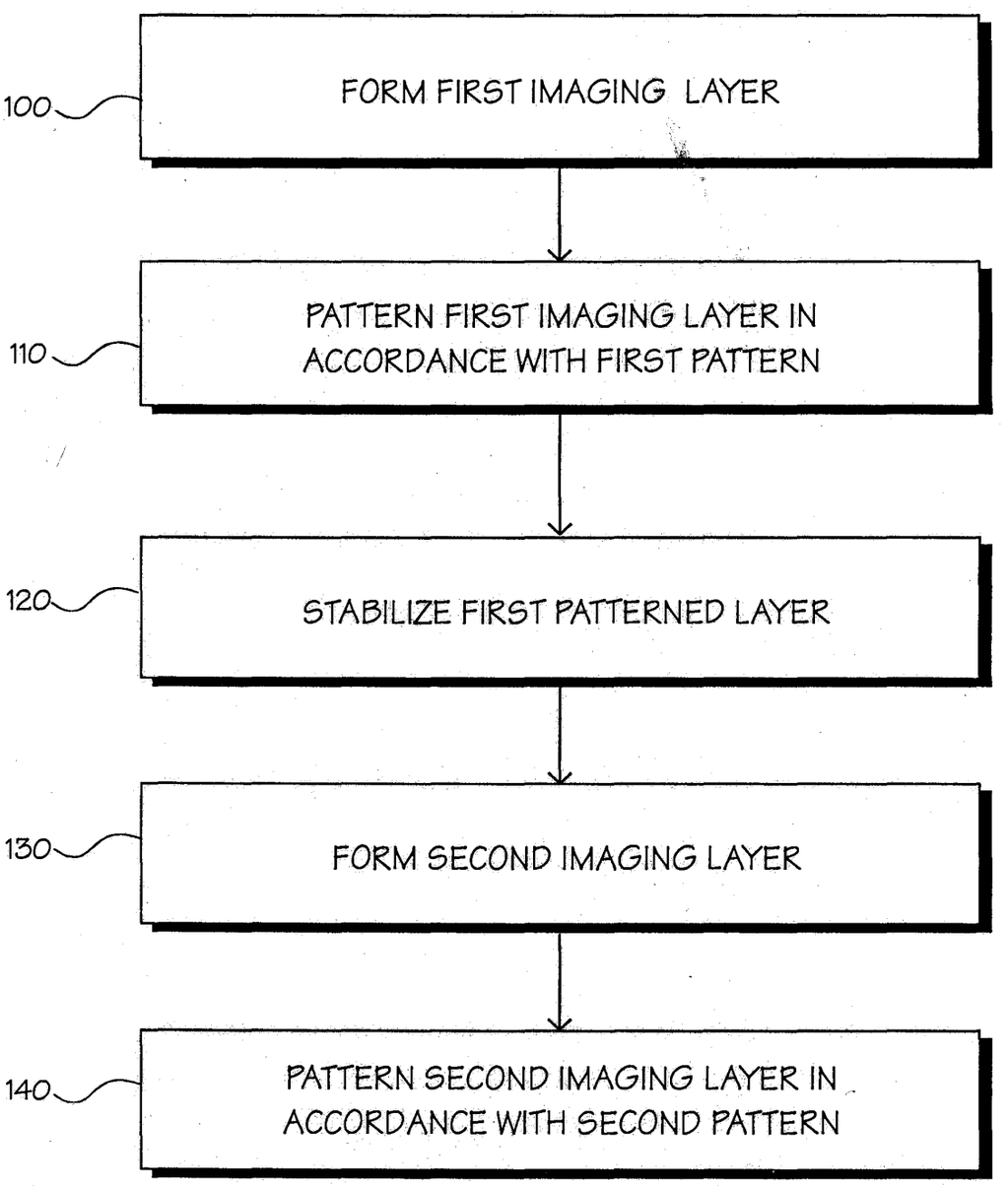

Fig.1

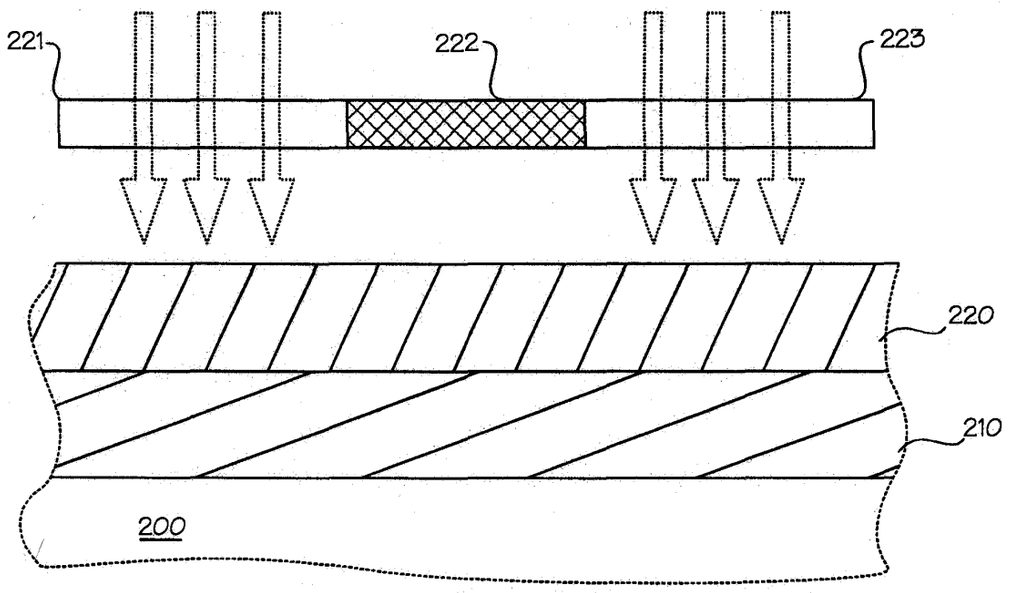

Fig.2

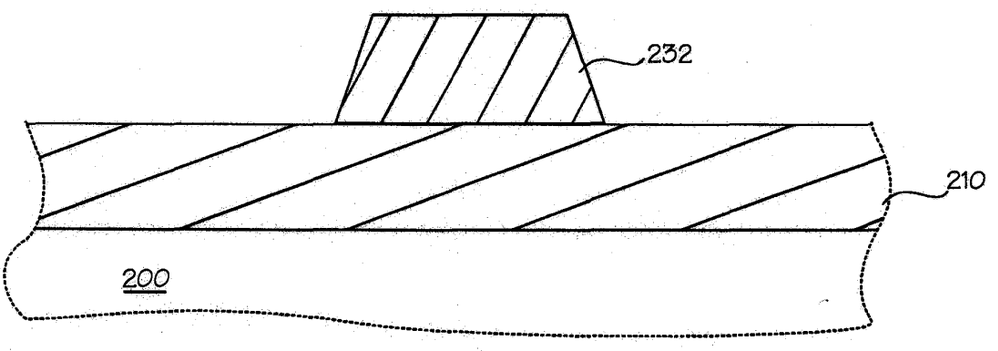

Fig.3

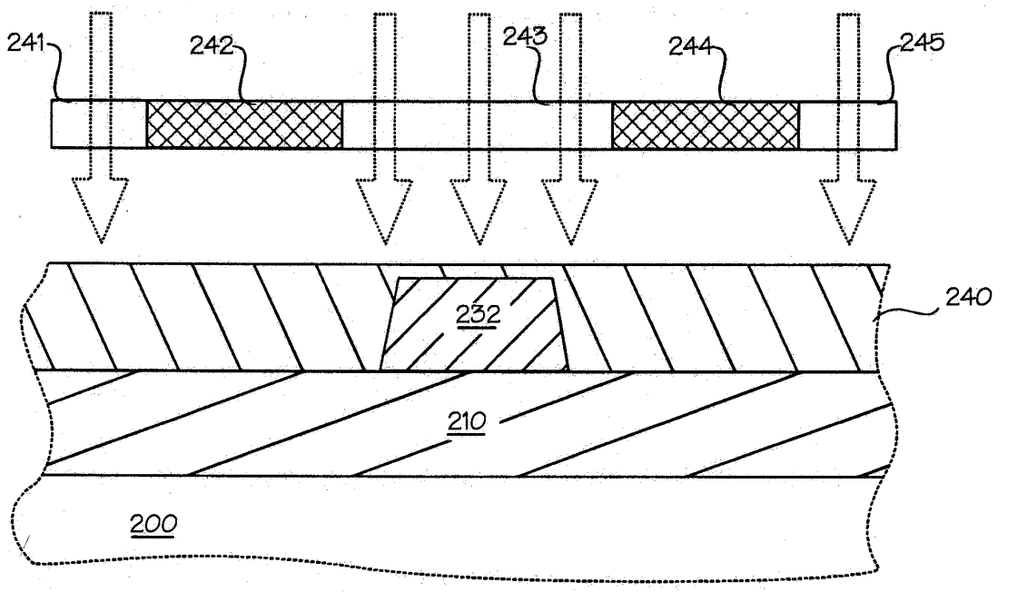

Fig4

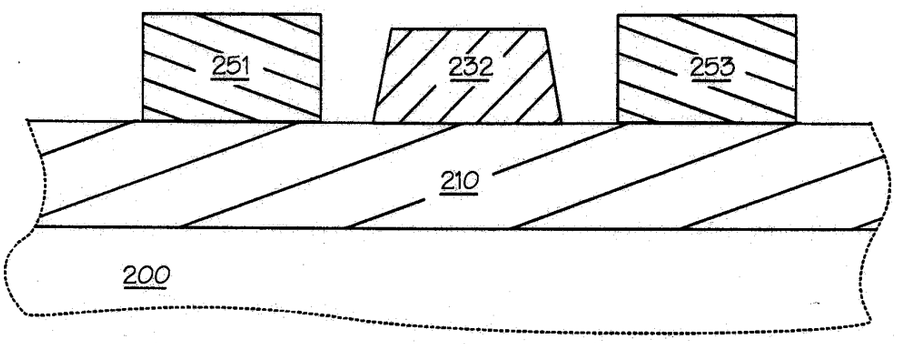

Fig.5

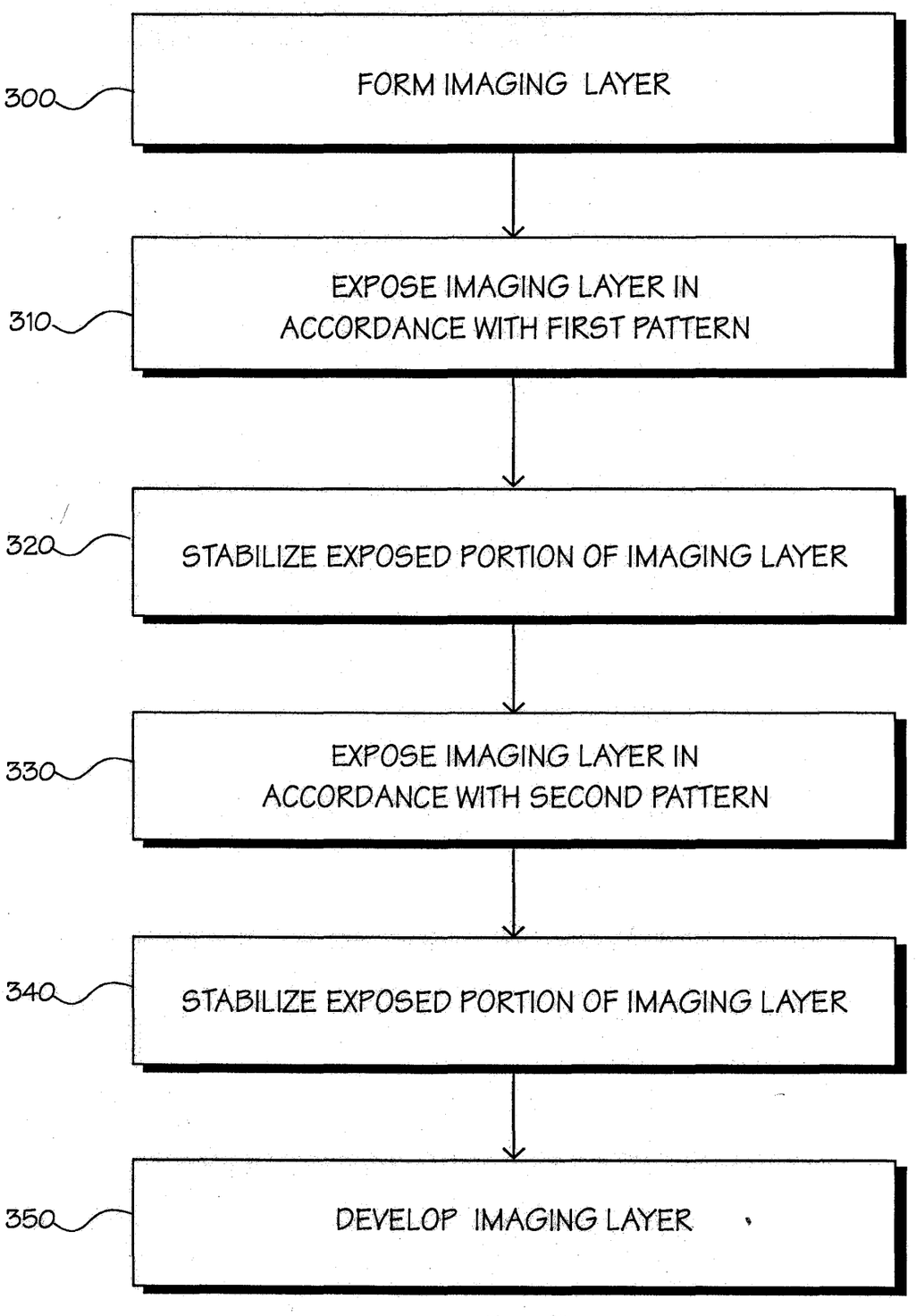

Fig.6

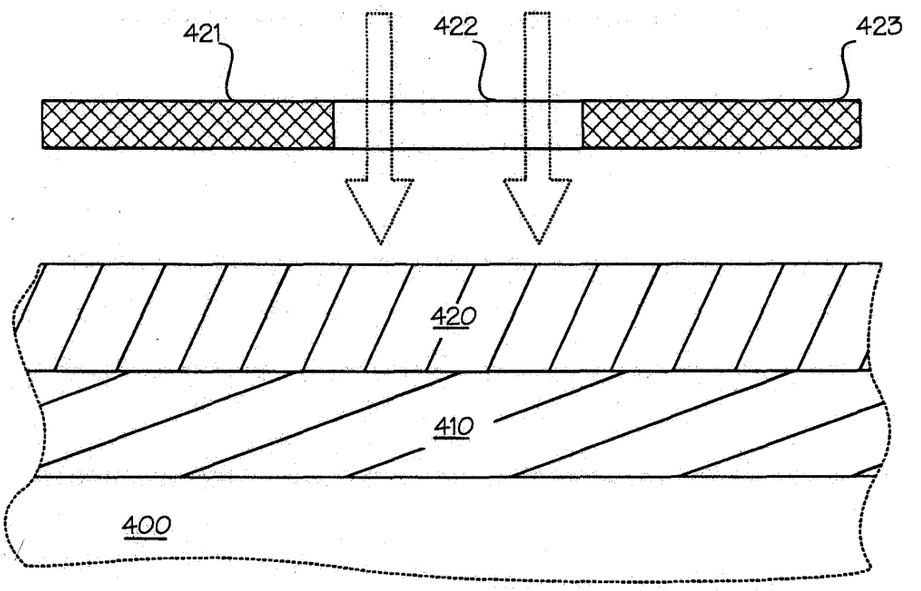

Fig7

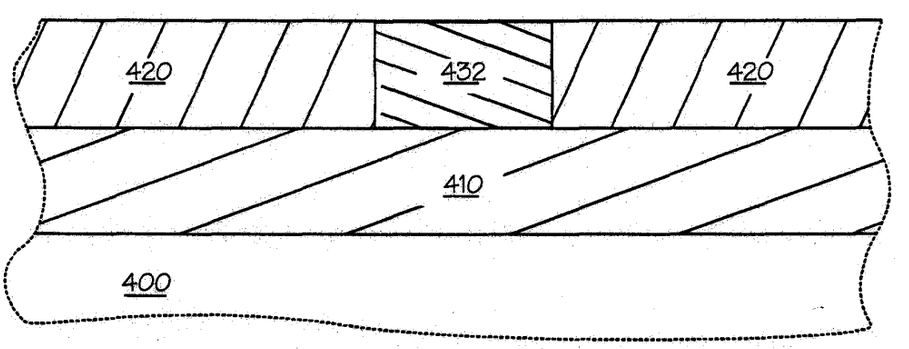

Fig.8

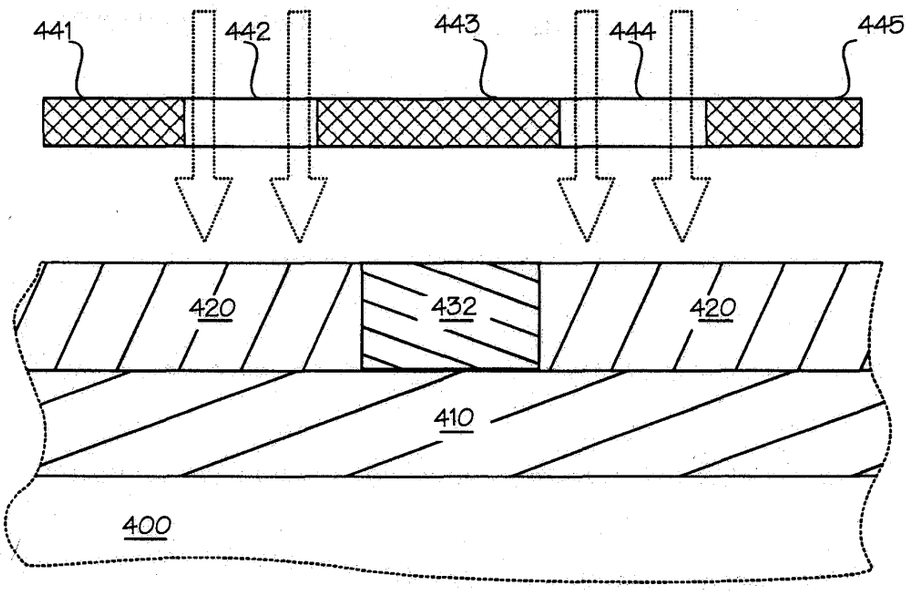

Fig9

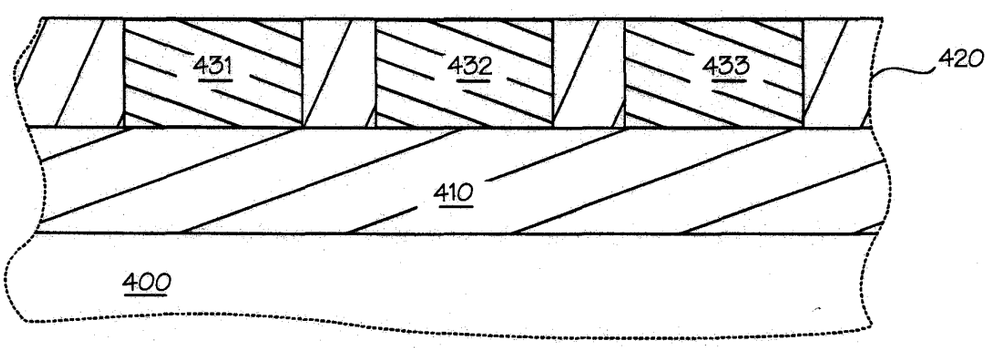

Fig.10

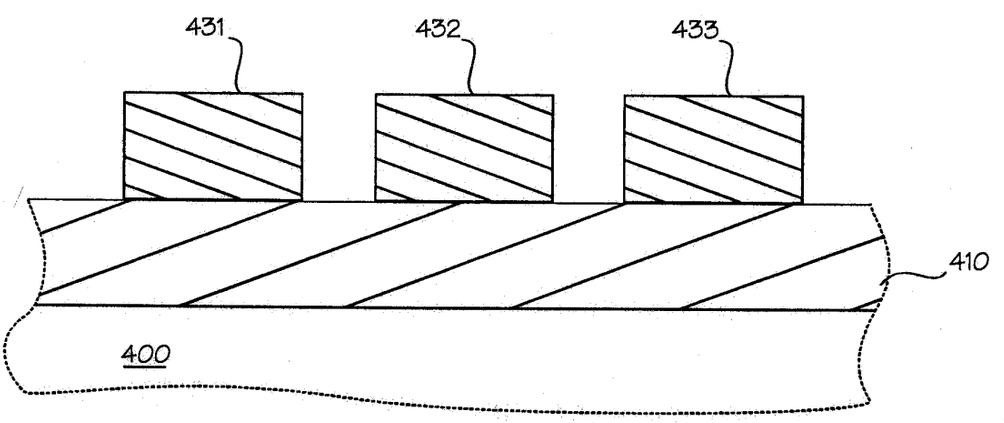

Fig.11

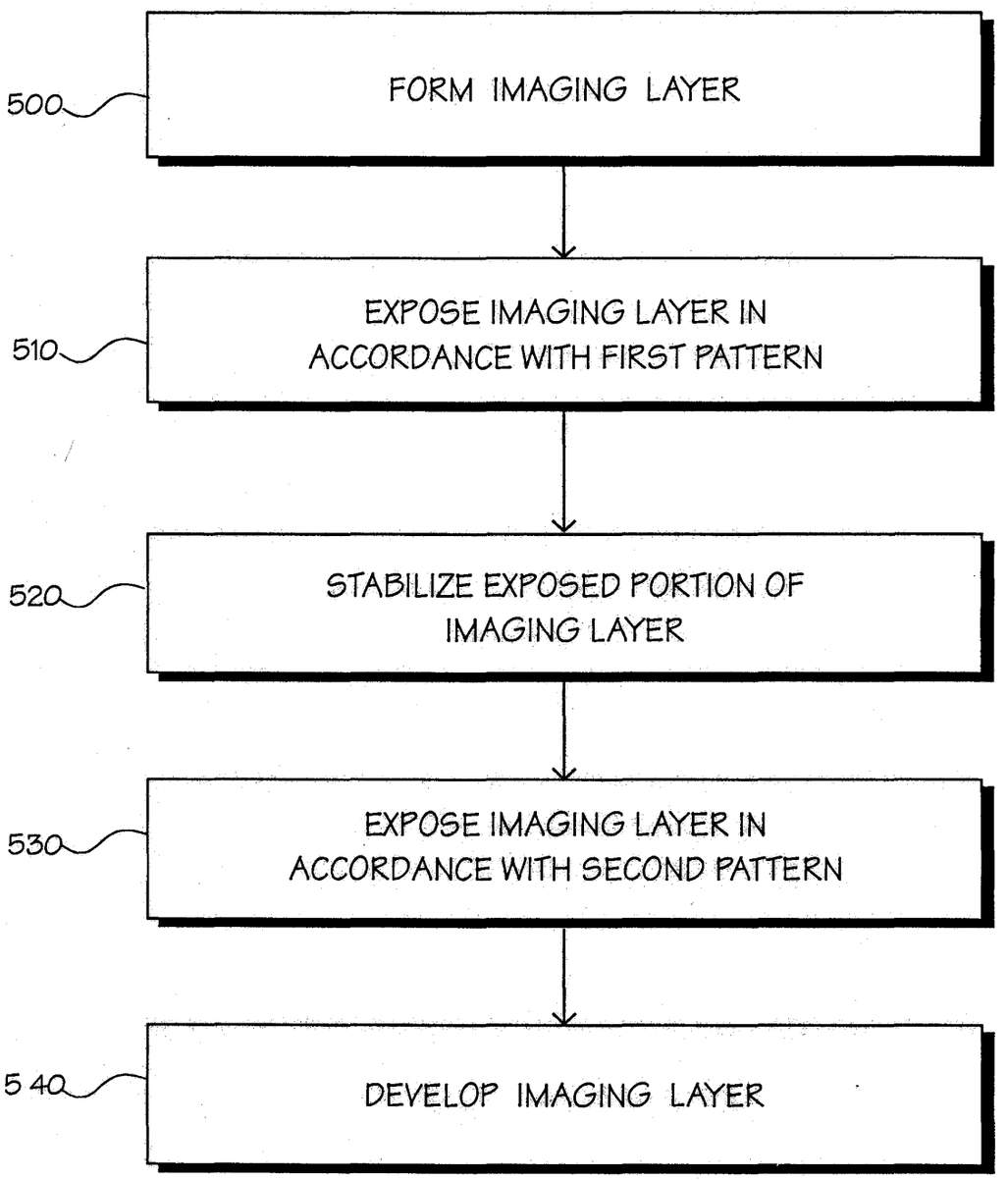

Fig.12

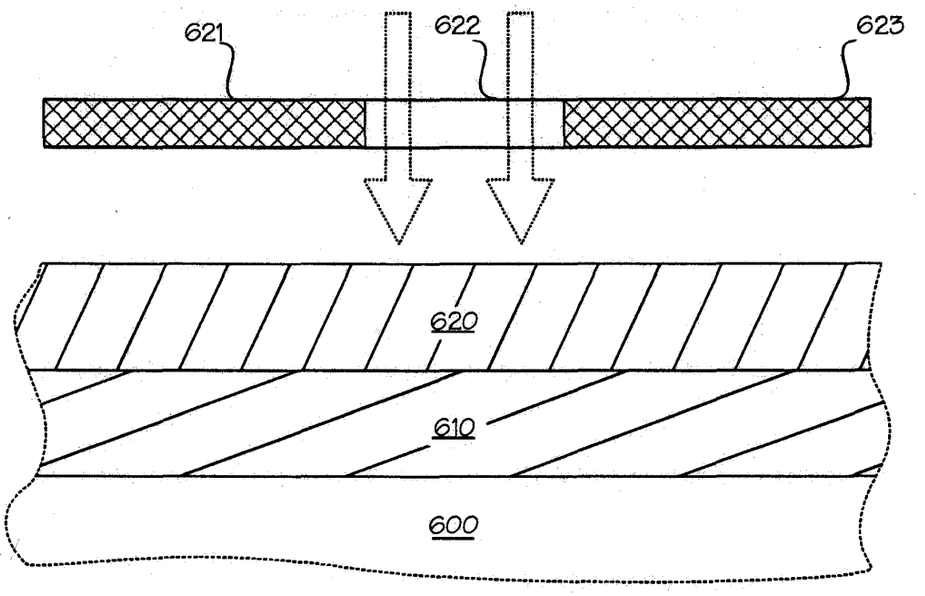

Fig13

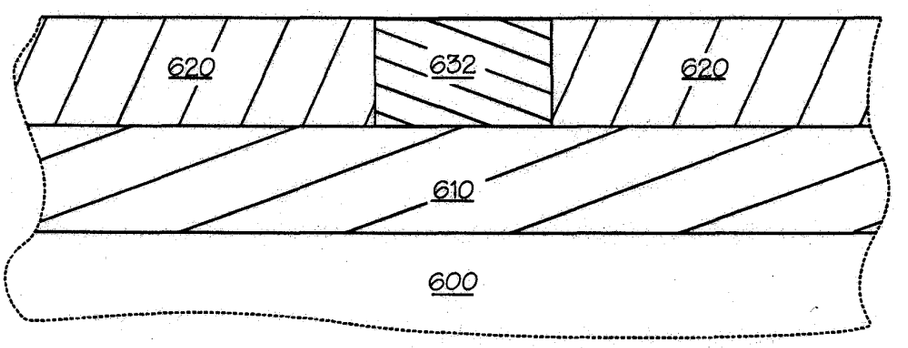

Fig.14

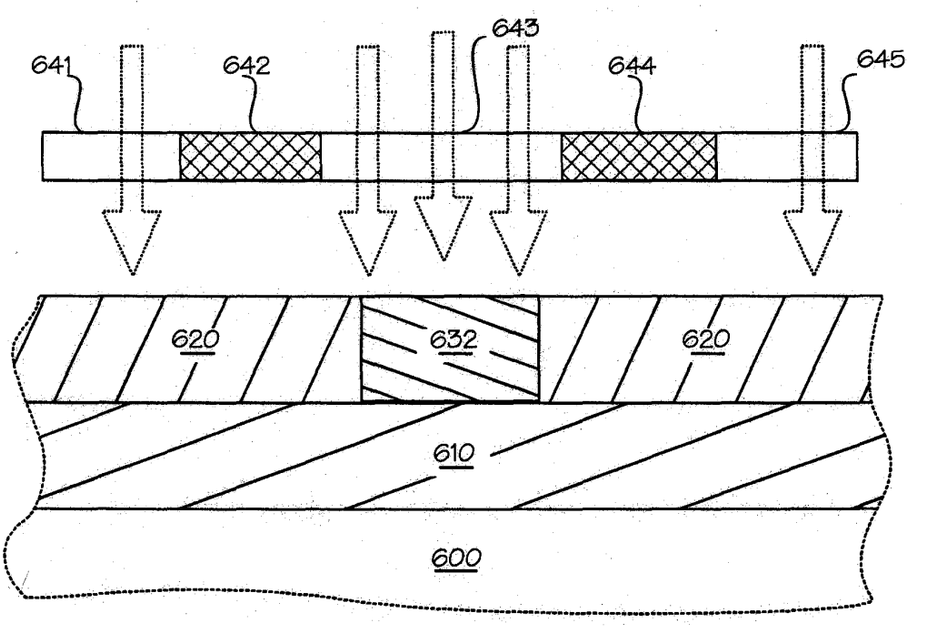

Fig15

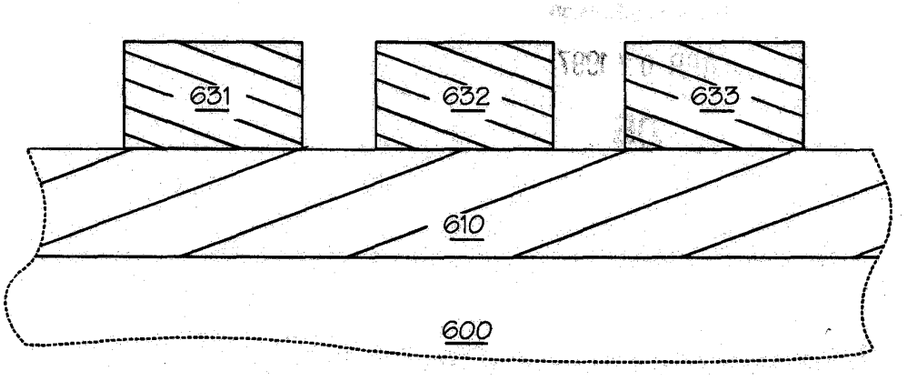

Fig.16

142-1290
561-30

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12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES CA 90025

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City, State and Zip Code
CO-INVENTOR'S NAME
Street Address
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APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
08/740,145	10/22/96	016	DUDA, K 1113	02/12/97

First Named Applicant: CLEEVES, JAMES M.

TITLE OF INVENTION: METHOD FOR REDUCED PITCH LITHOGRAPHY

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
1 16820.P048	430-315.000	J48	UTILITY	NO	$1290.00	05/12/97

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(1) NAME OF ASSIGNEE: CYPRESS SEMICONDUCTOR CORPORATION
(2) ADDRESS: (CITY & STATE OR COUNTRY) 3901 North First Street, California

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160 BS 04/21/97 08740145 1 142 1,290.00 CK
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on: April 4, 1997 (Date)
Patricia A. Balero (Name of person making deposit)
Patricia A. Balero (Signature)
4/4/97 (Date)

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12400 WILSHIRE BOULEVARD
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LOS ANGELES CA 90025

2. INVENTOR(S) ADDRESS CHANGE (Complete only if there is a change)

INVENTOR'S NAME

Street Address

City, State and Zip Code

CO-INVENTOR'S NAME

Street Address

City, State and Zip Code

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First Named Applicant: CLEEVES, JAMES M.

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3901 North First Street, California

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☒ Assignment previously submitted to the Patent and Trademark Office.

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Patricia A. Balero **(Name of person making deposit)**
Patricia A. Balero **(Signature)**
4/4/97 **(Date)**

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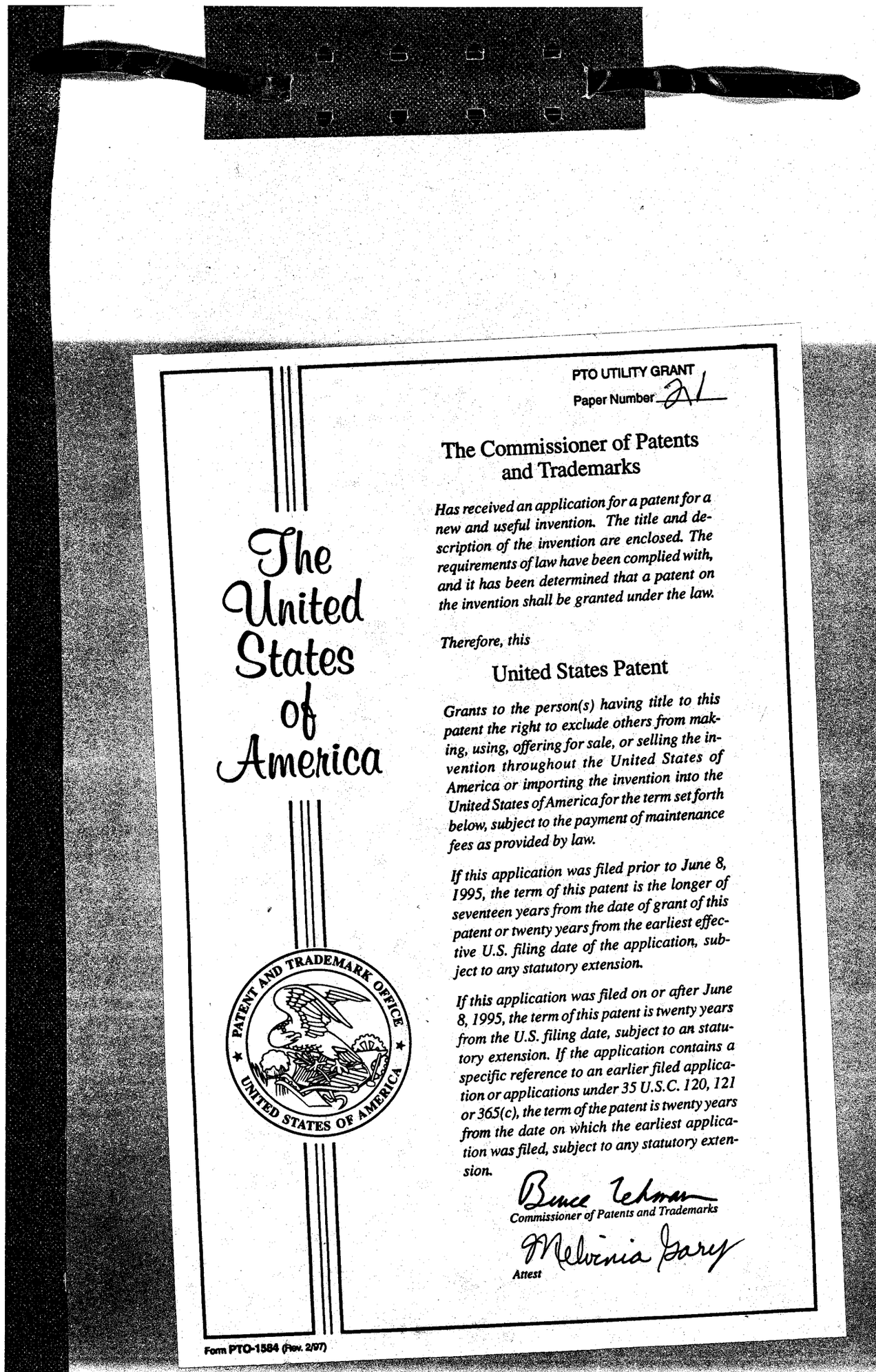

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Paper Number 21

The United States of America

The Commissioner of Patents and Trademarks

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.

If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.

If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to an statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extension.

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Commissioner of Patents and Trademarks

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REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT

Patent Number	**5,652,084**
Issue Date	**07/29/1997**
First Named Inventor	**James M. Cleeves**
Group Art Unit	**1113**
Examiner Name	**Duda, K.**
Attorney Docket Number	**016820.P048**

To: Assistant Commissioner for Patents
Washington, DC 20231

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The reasons for this request are:

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City	**Chicago**	**State**	**IL**	**Zip**	**60611-5599**
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Telephone		**Fax**			

This request is enclosed in triplicate.

Name	**Tarek N. Fahmi**	**Reg. No.: 41,402**
Signature		
Date	3/16/2000	

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REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT

Patent Number	5,652,084
Issue Date	07/29/1997
First Named Inventor	James M. Cleeves
Group Art Unit	1113
Examiner Name	Duda, K.
Attorney Docket Number	016820.P048

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To: Assistant Commissioner for Patents
Washington, DC 20231

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Address	**455 North Cityfront Plaza Drive, Suite 3600**				
City	**Chicago**	**State**	**IL**	**Zip**	**60611-5599**
Country					
Telephone		**Fax**			

This request is enclosed in triplicate.

Name	**Tarek N. Fahmi** **Reg. No.: 41,402**
Signature	
Date	3/14/2000

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William E. Alford, Reg. No. 37,764; Farzad E. Amini, Reg. No. P42,261; Aloysius T. C. AuYeung, Reg. No. 35,432; William Thomas Babbitt, Reg. No. 39,591; Carol F. Barry, Reg. No. 41,600; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Bereznak, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Ronald C. Card, Reg. No. 44,587; Andrew C. Chen, Reg. No. 43,544; Thomas M. Coester, Reg. No. 39,637; Alin Corie, Reg. No. P46,244; Dennis M. deGuzman, Reg. No. 41,702; Stephen M. De Klerk, under 37 C.F.R. § 10.9(b); Michael Anthony DeSanctis, Reg. No. 39,957; Daniel M. De Vos, Reg. No. 37,813; Robert Andrew Diehl, Reg. No. 40,992; Sanjeet Dutta, Reg. No. P46,145; Matthew C. Fagan, Reg. No. 37,542; Tarek N. Fahmi, Reg. No. 41,402; Paramita Ghosh, Reg. No. 42,806; James Y. Go, Reg. No. 40,621; James A. Henry, Reg. No. 41,064; Willmore F. Holbrow III, Reg. No. P41,845; Sheryl Sue Holloway, Reg. No. 37,850; George W Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; William W. Kidd, Reg. No. 31,772; Sang Hui Kim, Reg. No. 40,450; Eric T. King, Reg. No. 44,188; Erica W. Kuo, Reg. No. 42,775; Kurt P. Leyendecker, Reg. No. 42,799; Michael J. Mallie, Reg. No. 36,591; Andre L. Marais, under 37 C.F.R. § 10.9(b); Paul A. Mendonsa, Reg. No. 42,879; Darren J. Milliken, Reg. 42,004; Lisa A. Norris, Reg. No. 44,976; Chun M. Ng, Reg. No. 36,878; Thien T. Nguyen, Reg. No. 43,835; Thinh V. Nguyen, Reg. No. 42,034; Dennis A. Nicholls, Reg. No. 42,036; Daniel E. Ovanezian, Reg. No. 41,236; Marina Portnova, Reg. No. P45,750; Babak Redjaian, Reg. No. 42,096; William F. Ryann, Reg. 44,313; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Jeffrey Sam Smith, Reg. No. 39,377; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Judith A. Szepesi, Reg. No. 39,393; Vincent P. Tassinari, Reg. No. 42,179; Edwin H. Taylor, Reg. No. 25,129; John F. Travis, Reg. No. 43,203; George G. C. Tseng, Reg. No. 41,355; Joseph A. Twarowski, Reg. No. 42,191; Lester J. Vincent, Reg. No. 31,460; Glenn E. Von Tersch, Reg. No. 41,364; John Patrick Ward, Reg. No. 40,216; Mark L. Watson, Reg. No. P46,322; Thomas C. Webster, Reg. No. P46,154; Charles T. J. Weigell, Reg. No. 43,398; Kirk D. Williams, Reg. No. 42,229; James M. Wu, Reg. No. 45,241; Steven D. Yates, Reg. No. 42,242; and Norman Zafman, Reg. No. 26,250; my patent attorneys, and Justin M. Dillon, Reg. No. 42,486; my patent agent, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800, and James R. Thein, Reg. No. 31,710, my patent attorney.

Please type a plus sign (+) inside this box →

PTO/SB/83 (11-96)
Approved for use through 6/30/99. OMB 0651-0035
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT

Patent Number	**5,652,084**
Issue Date	**07/29/1997**
First Named Inventor	**James M. Cleeves**
Group Art Unit	**1113**
Examiner Name	**Duda, K.**
Attorney Docket Number	**016820.P048**

To: Assistant Commissioner for Patents
Washington, DC 20231

I hereby apply to withdraw as attorney or agent for the above identified application.

The reasons for this request are:

Discontinuation of the attorney client relationship.

1. ☐ **The correspondence address is NOT affected by this withdrawel.**
2. ☒ **Change the correspondence address and direct all future correspondence to:**

CORRESPONDENCE ADDRESS

☐ Customer Number *OR* [ ] →

Place Customer Number Bar Code Label here

☐ Firm *or* Individual Name	**Paul Rauch of Brinks, Hofer Gilson & Lione, P.C.**				
Address	**NBC Tower**				
Address	**455 North Cityfront Plaza Drive, Suite 3600**				
City	**Chicago**	**State**	**IL**	**Zip**	**60611-5599**
Country					
Telephone		**Fax**			

This request is enclosed in triplicate.

Name	**Tarek N. Fahmi**	**Reg. No.: 41,402**
Signature		
Date	3/16/2000	

Note: Withdrawal is effective when approved rather than when received. Unless there are at least 30 days between approval of withdrawal and the expiration date of a time period for response or possible extension period, the request to withdraw is normally disapproved.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
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PAYOR NUMBER
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P.O. BOX 10395
CHICAGO IL 60610

DATE PRINTED
02/02/09

MAINTENANCE FEE REMINDER

According to the records of the U.S. Patent and Trademark Office (USPTO) the maintenance fee for the patent(s) listed below (for which the above address is on record as the fee address under 37 CFR 1.363) has not been paid within the six-month period set forth in 37 CFR 1.362(d). THE MAINTENANCE FEE MAY STILL BE PAID WITH THE APPLICABLE SURCHARGE SET FORTH IN 37 CFR 1.20(h), WITHIN THE SIX-MONTH GRACE PERIOD SET FORTH IN 37 CFR 1.362(e).

Unless payment of the maintenance fee and the applicable surcharge is received in the USPTO within the six-month grace period, THE PATENT WILL EXPIRE AS OF THE END OF THE GRACE PERIOD. 35 U.S.C. 41(b).

The total payment due is the amount required on the date the fee is paid (and not necessarily the amount indicated below). All USPTO fees (including maintenance fees) are subject to change. Customers should refer to the USPTO Web site (www.uspto.gov) or call the Maintenance Fee Branch at 571-272-6500 for the most current fee amounts for the correct entity status before submitting payment. The total payment due indicated below is based on the entity status according to current Office records (shown below).

Timely payment of the total payment due is required in order to avoid expiration of the patent. A maintenance fee payment can be timely made using the certificate of mailing or transmission procedure set forth in 37 CFR 1.8.

PATENT NUMBER	FEE AMT	MAINT. SURCHG	U.S. APPL NUMBER	PATENT ISSUE DATE	APPL. FILING DATE	PAY-MENT YEAR	SMALL ENTITY?	TOTAL PYMT DUE	ATTORNEY DOCKET NUMBER
5652084	4110	130	08740145	07/29/97	10/22/96	12	NO	4240	16820.P048
5652504	2055	65	08491974	07/29/97	07/21/95	12	YES	2120	6551/008
6263904	2480	130	09679090	07/24/01	10/04/00	8	NO	2610	9584/30

The maintenance fee and the applicable surcharge can be paid quickly and easily over the Internet at www.uspto.gov by electronic funds transfer (EFT), credit card, or USPTO deposit account payment methods. The mailing address for all maintenance fee payments not electronically submitted over the Internet is: U.S. Patent and Trademark Office, P.O. Box 979070, St. Louis, MO 63197-9000.

Direct any questions about this notice to: Mail Stop M Correspondence, Director of the United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450.

NOTE: This notice was automatically generated based on the amount of time that elapsed since the date a patent was granted. It is possible that the patent term may have ended or been shortened due to a terminal disclaimer that was filed in the application. Also, for any patent that issued from an application filed on or after June 8, 1995 containing a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121, or 365(c), the patent term ends 20 years from the date on which the earliest such application was filed, unless the term was adjusted or extended under 35 U.S.C. 154 or 156. Patentee should determine the relevant patent term for a patent before paying the maintenance fee.

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 1994

Application or Docket Number: 361595

CLAIMS AS FILED - PART I

	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA
FOR		
BASIC FEE		
TOTAL CLAIMS	72 minus 20 =	* 2
INDEPENDENT CLAIMS	2 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
	365.00	OR		730.00
x$11=		OR	x$22=	44
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL		OR	TOTAL	774

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 24	Minus	** 22	= 2
Independent	* 4	Minus	*** 3	= 1
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=		OR	x$22=	44
x38=		OR	x76=	78
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 27	Minus	** 24	= 3
Independent	* 4	Minus	*** 4	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=		OR	x$22=	66.00
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	660

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
x$11=		OR	x$22=	
x38=		OR	x76=	
+120=		OR	+240=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 10/94)

Form PTO 1130
(REV 2/94)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

PACE DATA ENTRY CODING SHEET

1ST EXAMINER	D [illegible]	DATE	1-30-95
2ND EXAMINER	[illegible]	DATE	3-28-95

APPLICATION NUMBER	TYPE APPL	FILING DATE (MONTH DAY YEAR)	SPECIAL HANDLING	GROUP ART UNIT	CLASS	SHEETS OF DRAWING
08/361595	1	12 22 94	Ø	15Ø6	43Ø	1Ø

TOTAL CLAIMS	INDEPENDENT CLAIMS	SMALL ENTITY?	FILING FEE	FOREIGN LICENSE	ATTORNEY DOCKET NUMBER
22	2	Ø	-9Ø4	Y	1682Ø.PØ48

CONTINUITY DATA

CONT CODE	STATUS CODE	PARENT APPLICATION SERIAL NUMBER	PCT APPLICATION SERIAL NUMBER	PARENT PATENT NUMBER	PARENT FILING DATE (MONTH DAY YEAR)
			PCT/ /		
			PCT/ /		
			PCT/ /		
			PCT/ /		
			PCT/ /		

PCT/FOREIGN APPLICATION DATA

FOREIGN PRIORITY CLAIMED	COUNTRY CODE	PCT/FOREIGN APPLICATION SERIAL NUMBER	FOREIGN FILING DATE (MONTH DAY YEAR)

☆U.S.G.P.O.: 1994 - 385-974

TITLE OF INVENTION

ATTORNEY REGISTRATION NUMBERS

CORRESPONDENCE NAME AND ADDRESS

APPLICANT/INVENTOR DATA

AUTHORITY CODE	
FAMILY NAME	
GIVEN NAME	
CITY	

NAME SUFFIX	
STATE/CTRY CODE	

AUTHORITY CODE	
FAMILY NAME	
GIVEN NAME	
CITY	

NAME SUFFIX	
STATE/CTRY CODE	

MORE

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 1996

Application or Docket Number

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE	FEE		RATE	FEE
BASIC FEE				385.00	OR		770.00
TOTAL CLAIMS	16 minus 20 =	*	x$11=		OR	x$22=	
INDEPENDENT CLAIMS	3 minus 3 =	*	x40=		OR	x80=	
MULTIPLE DEPENDENT CLAIM PRESENT			+130=		OR	+260=	
			TOTAL		OR	TOTAL	770

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
Total	*	Minus	**	=	x$11=		OR	x$22=	
Independent	*	Minus	***	=	x40=		OR	x80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+130=		OR	+260=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1)		(Column 2)	(Column 3)	RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA					
Total	*	Minus	**	=	x$11=		OR	x$22=	
Independent	*	Minus	***	=	x40=		OR	x80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+130=		OR	+260=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1)		(Column 2)	(Column 3)	RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA					
Total	*	Minus	**	=	x$11=		OR	x$22=	
Independent	*	Minus	***	=	x40=		OR	x80=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+130=		OR	+260=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 10/96)

*U.S. Government Printing Office: 1996 - 413-288/49191

Form PTO 1130
(REV 2/94)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

PACE DATA ENTRY CODING SHEET

1ST EXAMINER: [signature] DATE: 11/12/96

2ND EXAMINER: DATE:

APPLICATION NUMBER	TYPE APPL	FILING DATE MONTH	DAY	YEAR	SPECIAL HANDLING	GROUP ART UNIT	CLASS	SHEETS OF DRAWING
	2	10	22	96		1713	430	10

TOTAL CLAIMS	INDEPENDENT CLAIMS	SMALL ENTITY?	FILING FEE	FOREIGN LICENSE	ATTORNEY DOCKET NUMBER
16	3	0	770	Y	16820.P048

CONTINUITY DATA

CONT CODE	STATUS CODE	PARENT APPLICATION SERIAL NUMBER	PCT APPLICATION SERIAL NUMBER	PARENT PATENT NUMBER	PARENT FILING DATE MONTH	DAY	YEAR
02	3	08/361,595			12	29	94

PCT/FOREIGN APPLICATION DATA

FOREIGN PRIORITY CLAIMED	COUNTRY CODE	PCT/FOREIGN APPLICATION SERIAL NUMBER	FOREIGN FILING DATE MONTH	DAY	YEAR

☆ U.S. GPO: 1995-401-429

TITLE OF INVENTION

ATTORNEY REGISTRATION NUMBERS

CORRESPONDENCE NAME AND ADDRESS

APPLICANT/INVENTOR DATA

AUTHORITY CODE	
FAMILY NAME	
GIVEN NAME	
CITY	
NAME SUFFIX	
STATE/CTRY CODE	

AUTHORITY CODE	
FAMILY NAME	
GIVEN NAME	
CITY	
NAME SUFFIX	
STATE/CTRY CODE	

MORE