2 | Class 430 | ISSUE CLASSIFICATION

5686223

NOV 11 1997

SERIAL NUMBER | PATENT NUMBER

SERIAL NUMBER	FILING DATE	CLASS	SUBCLASS	GROUP ART UNIT	EXAMINER
08/740,014	10/23/96	430	311 312	1113	Duda

APPLICANTS: JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA***********************
VERIFIED THIS APPLN IS A DIV OF 08/510,717 08/03/95 ABN
WHICH IS A DIV OF 08/361,595 12/22/94 ABN
KAD

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

FOREIGN FILING LICENSE GRANTED 11/17/96

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 / KAD Examiner's initials	→	CA	10	18	2	$770.00	16820.P049D

ADDRESS: BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
SEVENTH FLOOR
12400 WILSHIRE BOULEVARD
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: 6/2/97

Assistant Examiner

CLAIMS ALLOWED: Total Claims 18; Print Claim 1 and 15

ISSUE FEE: Amount Due $1290; Date Paid 7/31/97

Kathleen Duda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100
Primary Examiner

DRAWING: Sheets Drwg. 10; Figs. Drwg. 16; Print Fig. 6,12,15&16

ISSUE BATCH NUMBER N63

Label Area

PREPARED FOR ISSUE

WARNING: The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Code Title 35, Sections 122, 181 and 368. Possession outside the U.S. Patent & Trademark Office is restricted to authorized employees and contractors only.

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

ISSUE FEE IN FILE

(FACE)

08/510717	Class	Subclass	ISSUE CLASSIFICATION

UTILITY SERIAL NUMBER 08/510717	PATENT DATE	PATENT NUMBER

SERIAL NUMBER	FILING DATE	CLASS	SUBCLASS	GROUP ART UNIT	EXAMINER
08/510,717	08/03/95 RULE 60	430	311	~~1507~~ 1113	K. DUDA

JAMES M. CLEEVES, REDWOOD CITY, CA.

430/311 K. DUDA Pending

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

FOREIGN/PCT APPLICATIONS**********
VERIFIED None
KAD

FOREIGN FILING LICENSE GRANTED 09/07/95

Foreign priority claimed ☐ yes ☒ no; 35 USC 119 conditions met ☐ yes ☒ no; Verified and Acknowledged KAD Examiner's initials	AS FILED	STATE OR COUNTRY	SHEETS DRWGS.	TOTAL CLAIMS	INDEP. CLAIMS	FILING FEE RECEIVED	ATTORNEY'S DOCKET NO.
	→	CA	10	11	1	$730.00	16820.P048D

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

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

ISSUE FEE

Amount Due	Date Paid

Primary Examiner

DRAWING

Sheets Drwg.	Figs. Drwg.	Print Fig.

ISSUE BATCH NUMBER

PREPARED FOR ISSUE

Label Area

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

(FACE)

08/510717

PATENT APPLICATION

08510717

APPROVED FOR LICENSE

INITIALS

RECEIVED OCT 6 1995

CONTENTS

Date Entered or Counted			Date Received or Mailed
	1.	Application papers.	
	2.	IDS	8/3/95
	3.	Pre Amdt A	8/3/95
11/27 R	4.	Rej (3 mos)	11-28-95
HP	5.	Amdt B Cfm	3-5-96
HP	6.	IDS w/References	4-19-96
5/28	7.	Final Rej B	5-28-96
	8.	Ext. of time 1 mo.	9/30/96
	9.	Amdt C (N.E.)	9/30/96
RS 10-10	10.	ADV. ACT	10-10-96
	11.	Ext. of time 2 mos.	10/23/96
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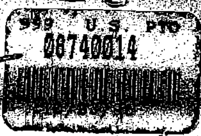

PATENT APPLICATION

08740014

APPROVED FOR LICENSE ☐

INITIALS ______

Date Entered or Counted	CONTENTS	Date Received or Mailed
	Application ✓ papers. 4 Pres	
12	D Pre amdt C	10/23/96
13	Pre amdt D	10/23/96
14	Rejection	1/9/97
15	Amdt E	03/17/97
6/21 16	Notice of Allowance/Allowability	6/2/97
17	PTO Grant NOV 11 1997	
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POSITION		ID NO.	DATE
CLASSIFIER		45	8-31-95
EXAMINER		351	9-1-95
TYPIST		MBS	9-7
VERIFIER		277	9-7
CORPS CORR.			
SPEC. HAND			
FILE MAINT.			
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INDEX OF CLAIMS

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SYMBOLS

- ✓ .... Rejected
- = ... Allowed
- - (Through numeral) Canceled
- ÷ .... Restricted
- N .... Non-elected
- I .... Interference
- A .... Appeal
- O .... Objected

Claim Final	Claim Original	Date	Date	Date	Date	Date	Date	Date	Date
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POSITION		ID NO.	DATE
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EXAMINER			
TYPIST		335	11-17-96
VERIFIER			
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SPEC. HAND			
FILE MAINT.			
DRAFTING			

INDEX OF CLAIMS

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SYMBOLS

- ✓ .... Rejected
- = ... Allowed
- \- (Through numeral) Canceled
- \+ .... Restricted
- N .... Non-elected
- I .... Interference
- A .... Appeal
- O .... Objected

Claim		Date						
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STAPLE AREA

★ U.S. GOVERNMENT PRINTING OFFICE: 1997-424-353

PATENT NUMBER

APPLICATION SERIAL NUMBER

08/740,014

APPLICANT'S NAME (PLEASE PRINT)

Cleeves

IF REISSUE, ORIGINAL PATENT NUMBER

—

INTERNATIONAL CLASSIFICATION 6

G	0	3	F		7/20
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ORIGINAL CLASSIFICATION

CLASS	SUBCLASS
430	312

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)			
430	315	330	394	

GROUP ART UNIT: 1113

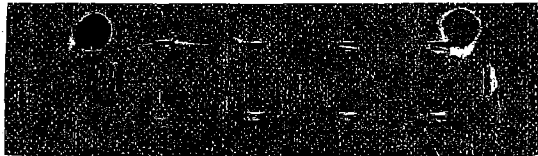
ASSISTANT EXAMINER (PLEASE STAMP OR PRINT FULL NAME): —

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, 312, 315, 324, 330, 394	11/22/95	KMD
updated search		5/26/96	KMD

related 361595

SEARCH NOTES

	Date	Exmr.
none	11/22/95	KMD

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.

(RIGHT OUTSIDE)

SEARCHED

Class	Sub.	Date	Exmr.
updated parent search			
430	311, 312, 315, 324, 330, 394	1/6/97	KHD
updated search		5/29/97	KHD

SEARCH NOTES

	Date	Exmr.
none	5/29/97	KHD

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.
430	311, 312, 315, 324, 330, 394	5/29/97	KHD

(RIGHT OUTSIDE)

08/510717

PATENT APPLICATION SERIAL NO. 08/510717

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

290 SB 08/29/95 08510717
1 101 730.00 CK 16820.P048D

PTO-1556
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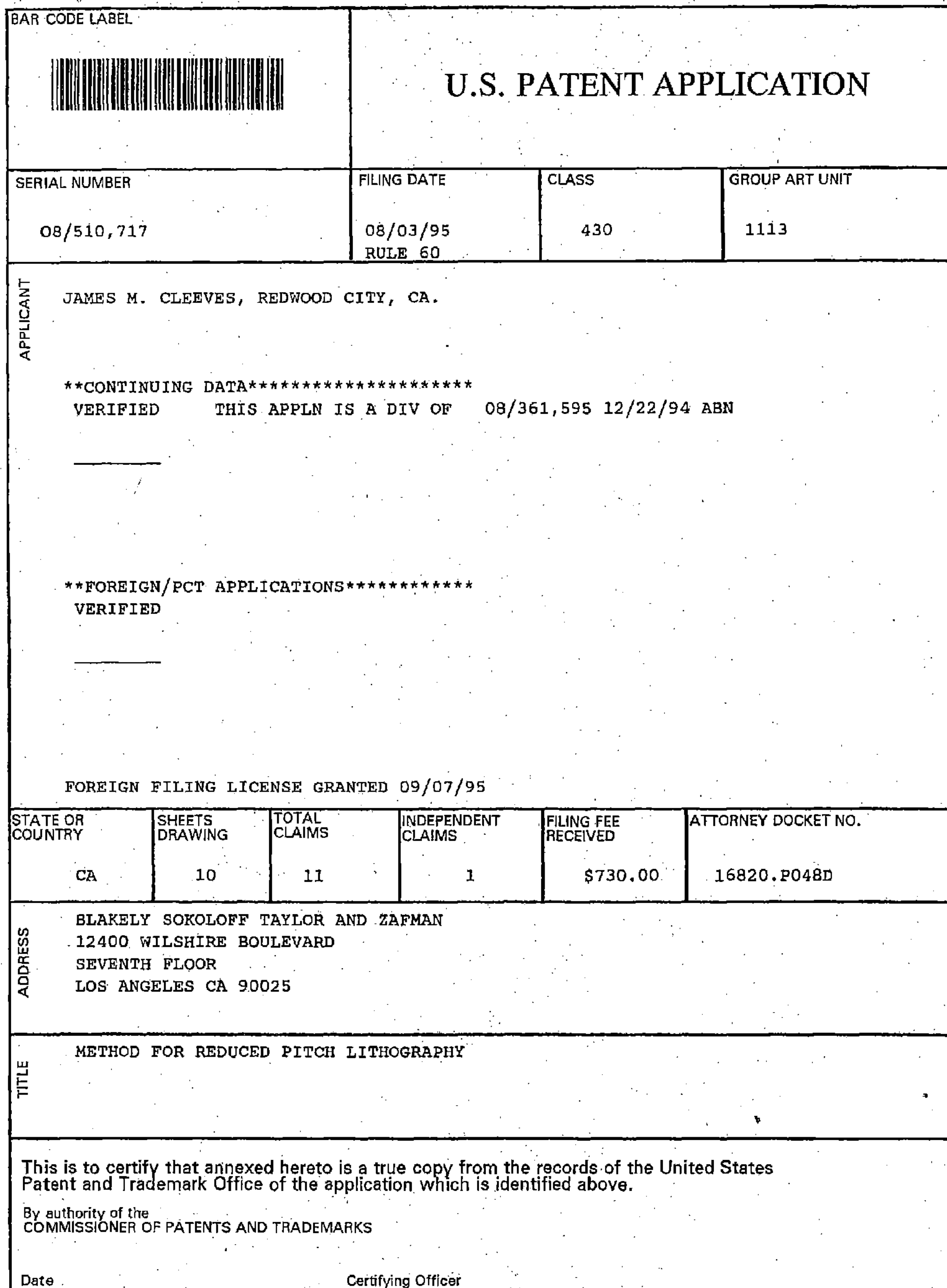

BAR CODE LABEL

U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/510,717	08/03/95 RULE 60	430	1113

APPLICANT

JAMES M. CLEEVES, REDWOOD CITY, CA.

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

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

FOREIGN FILING LICENSE GRANTED 09/07/95

STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS	FILING FEE RECEIVED	ATTORNEY DOCKET NO.
CA	10	11	1	$730.00	16820.P048D

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

08/510717

Attorney's Docket No.: 16820.P048D

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

Prior Application:
Examiner: Duda, K.
Art Unit: 1507

RULE 60

SIR: This is a request for filing a

_____ Continuation application   X Divisional application

under 37 C.F.R. § 1.60 of pending prior application serial 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. **Enclosed is a complete copy of the prior application including the specification (including claims), the oath or declaration showing the signature or an indication that it was signed, and any amendment referred to in the oath or declaration filed to complete the application. (See below for drawing requirements.) I hereby verify that the attached papers are a true copy of the prior application serial no. 08/361,595 as originally filed on December 22, 1994.**

X 2. **Copies of the drawings filed in the prior application are enclosed herewith.**

_____ 3. Transfer the drawings from the prior application and **abandon** said prior application as of the filing date accorded this application. A duplicate copy of this sheet is enclosed for filing in the prior application file. (May only be used if signed by person authorized by 37 C.F.R. § 1.138 and before payment of base issue fee.)

_____ 4. New formal drawings are enclosed.

X 5. The filing fee is calculated below:

CLAIMS AS FILED IN THE PRIOR APPLICATION LESS ANY CLAIMS CANCELED BY AMENDMENT BELOW

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

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

"Express Mail" mailing label number TB907642373US

Date of Deposit 8-3-95

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

Alice Tam
(Typed or printed name of person mailing paper or fee)

[signature]
(Signature of person mailing paper or fee)

LJV/wes/cak (10/01/94) Rule 60

_______ 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 prior application **and such status is still proper and desired.** 37 C.F.R. § 1.28(a).

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

__X__ 8. A check in the amount of $ 730.00 is enclosed for the filing fee.

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

__X__ 10. Cancel in this application original claims 1-11 of the prior application before calculating the filing fee (wherein at least one independent claim is retained for filing purposes).

_______ 11. A preliminary amendment is enclosed. (Claims added by this amendment should be numbered consecutively beginning with the number next following the highest numbered original claim in the prior application. Only an amendment reducing the number of claims or adding a reference to the prior application will be entered before calculating the filing fee and granting the filing date.)

__X__ 12. Amend the specification by inserting the following before the first sentence on the first page:

__X__ (a) -- This is a ________ continuation/ X divisional of application serial no. 08/361,595, filed December 22, 1994.--

_______ (b) --, which is a ________ continuation/ ________ divisional of application serial no. __________, filed __________ __________.--

(list all prior applications)

__X__ 13. It is hereby requested that any request for a convention priority made in the prior application be transferred to this Rule 60 application.

_______ 14. The prior application is assigned of record to:

____

__X__ 15. The Power of Attorney in the prior application is to:

__________ (Name) (Reg. No.)

Edwin H Taylor, Reg. No. 25,129, and certain other listed attorneys or agents of:
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN
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 serial no. 08/361,595 filed December 22, 1994.

_______ (b) Because the Power does not appear in the original papers, a copy of the Power in the prior application is enclosed.

_______ (c) Recognize as an associate attorney or agent and address all future communications to:

__________ (Name) (Reg. No.)

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(408) 720-8598

_______ (d) Address all future communications to the undersigned.

_______ 16. **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____ 17. Applicant(s) hereby petition(s) for an extension of time pursuant to Rule 1.136, if needed, for the above-noted prior application. The 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.

_______ 18. Accompanying this application is a statement requesting deletion of the name(s) of the person or persons who are not inventors of the invention being claimed in the continuation/divisional application. 37 C.F.R § 1.60(b).

The undersigned declares further that all statements made herein of his or her 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 issuing thereon.

Respectfully submitted,

BLAKELY SOKOLOFF TAYLOR & ZAFMAN

Date: 8/3/95

By Michael A. Bernadicou

Reg. No. 35,934

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

_X____ Attorney or Agent of Record

_______ Associate Attorney or Agent

_______ Filed Under 37 C.F.R. § 1.34(a)

08/~~510717~~ 740014

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

Date of Deposit: December 22, 1994

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 C.F.R. § 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

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

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

08/~~510717~~ 740014

METHOD FOR REDUCED PITCH LITHOGRAPHY

BACKGROUND OF THE INVENTION

1. Field of the Invention:

5 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
10 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
15 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.

20 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
25 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

5 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

10 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

15 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

20 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:

5 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 10 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 15 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;

20 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 25 Figure 9 after an exposed portion of the imaging layer has been stabilized;

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;

5 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

10 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, 5 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.

10 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 15 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 20 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 25 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.

5 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 10 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-15 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 20 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 25 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
5 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
10 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
15 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
20 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
25 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.

5 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 10 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.

15 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 20 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 25 the range of approximately 100 nanometers to approximately 500 nanometers, and

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 ~~silation~~ 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.

5 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

10 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.

15 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

20 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

25 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 5 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 10 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 15 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 20 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 25 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
5 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
10 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
15 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
20 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
25 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
5 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.

10 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
15 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
20 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
25 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
5 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.

10 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
15 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,
20 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
25 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)
5 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
10 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
15 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
20 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
25 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
5 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.

10 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.

15 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
20 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
5 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
10 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.

15 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
20 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
5 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.

10 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
15 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.

20 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.
5 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.

10 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
15 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
20 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
25 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
5 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
10 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
15 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
20 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
5 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
10 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
15 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
20 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
25 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.

5 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 10 632 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.

15 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 20 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 25 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
5 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.

10 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
15 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
20 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
25 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.

5

What is claimed is:

1 1. A lithography method for semiconductor fabrication using a semiconductor
2 wafer, comprising the steps of:
3 (a) forming a first imaging layer over the semiconductor wafer;
4 (b) patterning the first imaging layer in accordance with a first pattern to
5 form a first patterned layer;
6 (c) stabilizing the first patterned layer;
7 (d) forming a second imaging layer over the first patterned layer such that
8 the first patterned layer is surrounded by the second imaging layer; and
9 (e) patterning the second imaging layer in accordance with a second
10 pattern to form a second patterned layer.

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

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

1 4. The method of claim 1, wherein the patterning step (b) includes the steps of:
2 (i) exposing a portion of the first imaging layer to radiation in accordance
3 with the first pattern, and
4 (ii) developing the first imaging layer such that the exposed portion
5 dissolves to form the first patterned layer.

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

2 (i) exposing a portion of the second imaging layer to radiation in
3 accordance with the second pattern, and
4 (ii) developing the second imaging layer such that the exposed portion
5 dissolves to form the second patterned layer.

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

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

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

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

1 10. The method of claim 1, wherein the stabilizing step (c) includes the steps of:
2 (i) exposing the first patterned layer to radiation, and
3 (ii) heating the first patterned layer.

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

4 wherein the heating step (c)(ii) includes the step of heating the first patterned

5 layer at a temperature ramped to approximately 230 degrees Celsius.

1 12. A lithography method for semiconductor fabrication using a semiconductor
2 wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a portion of the imaging layer to radiation in accordance with
5 a first pattern;
6 (c) stabilizing the exposed portion of the imaging layer; and
7 (d) patterning the imaging layer in accordance with a second pattern to
8 form a patterned layer.

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

1 14. The method of claim 12, wherein the patterning step (d) includes the steps of:
2 (i) exposing the imaging layer to radiation in accordance with the second
3 pattern, and
4 (ii) developing the imaging layer to form the patterned layer.

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

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

1 17. The method of claim 12, wherein the stabilizing step (c) includes the step of
2 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
5 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
10 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

____ 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.

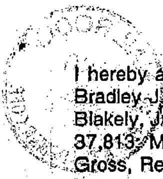
I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

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.

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 1-00

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 ____________

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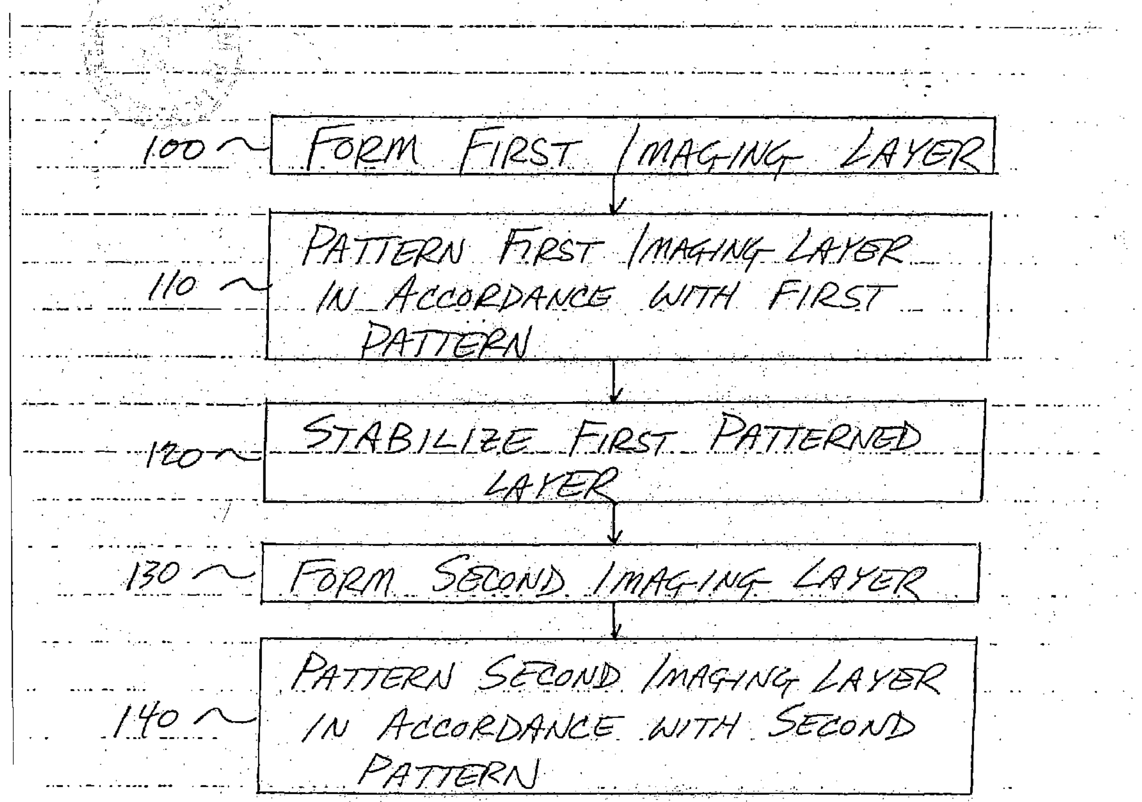

FIG. 1

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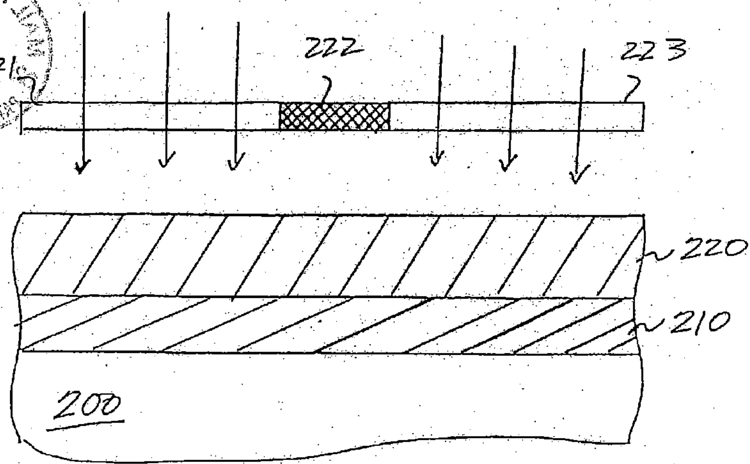

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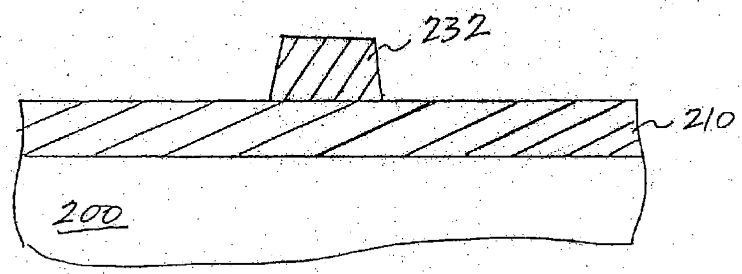

FIG. 3

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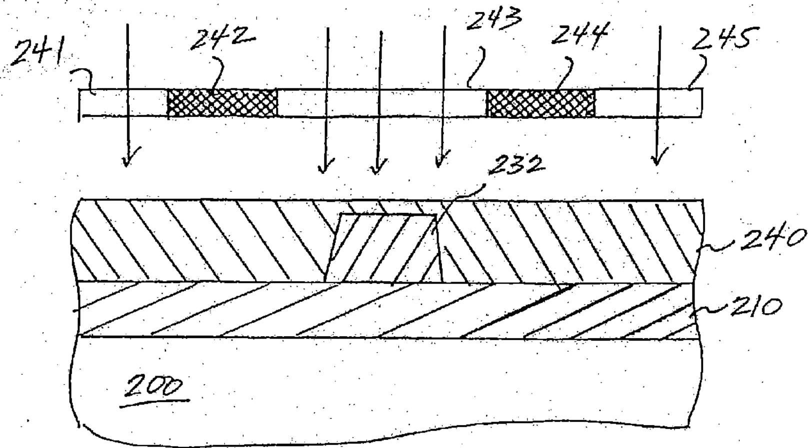

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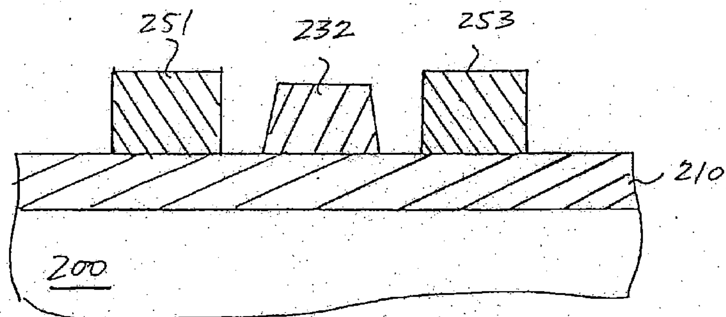

FIG. 5

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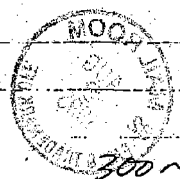

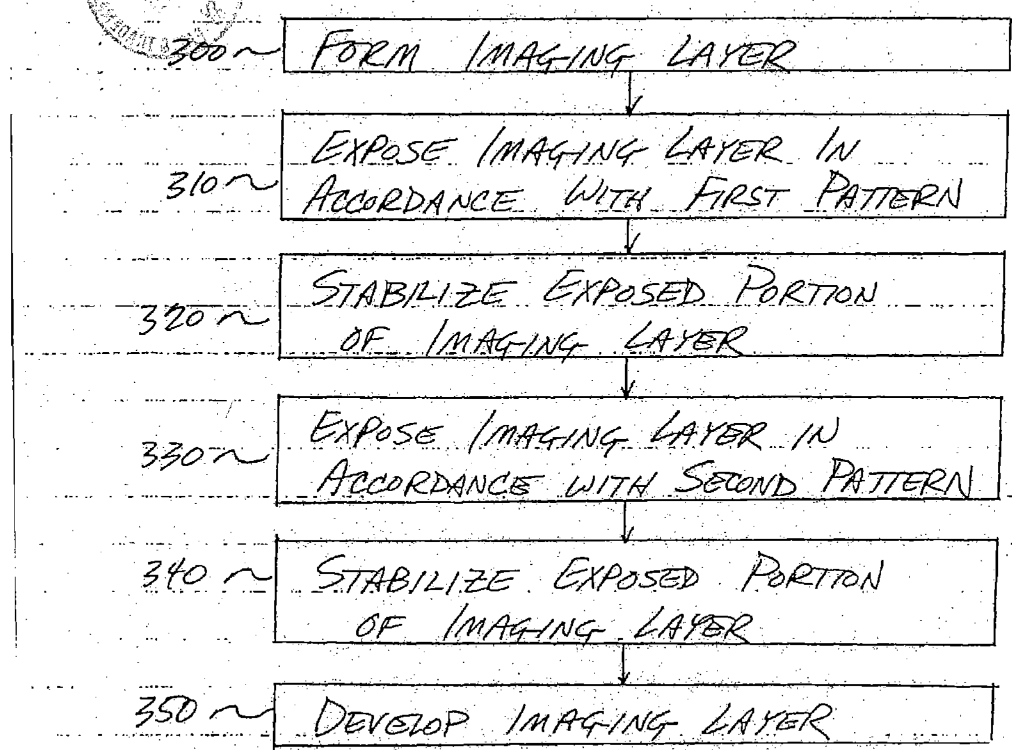

FIG. 6

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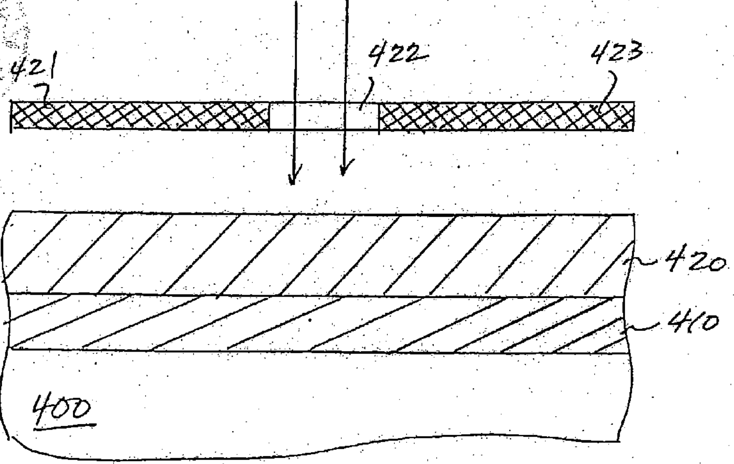

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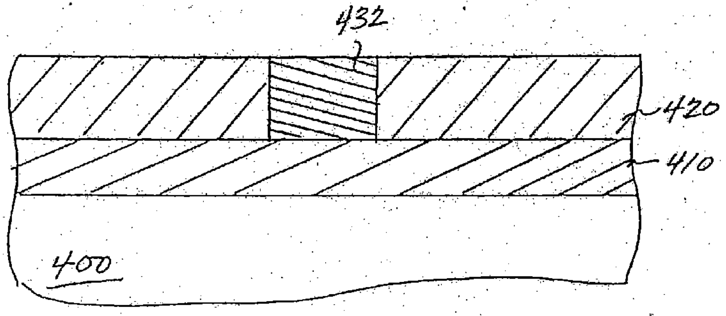

FIG. 8

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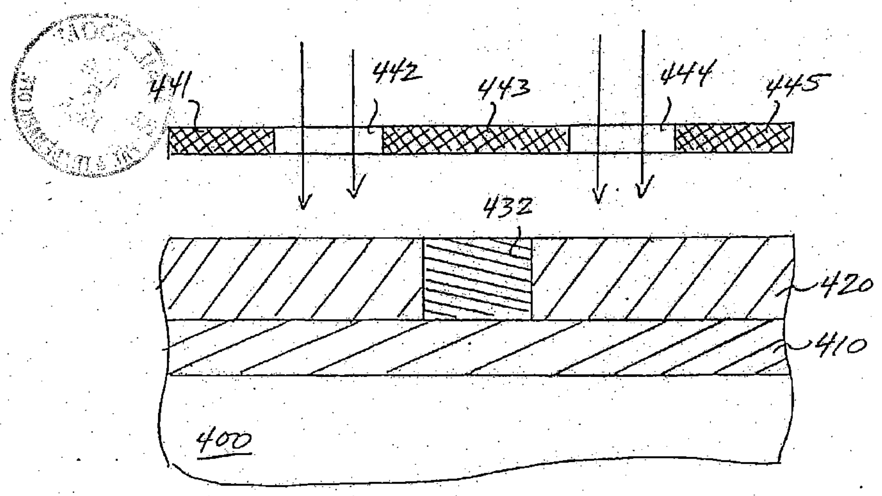

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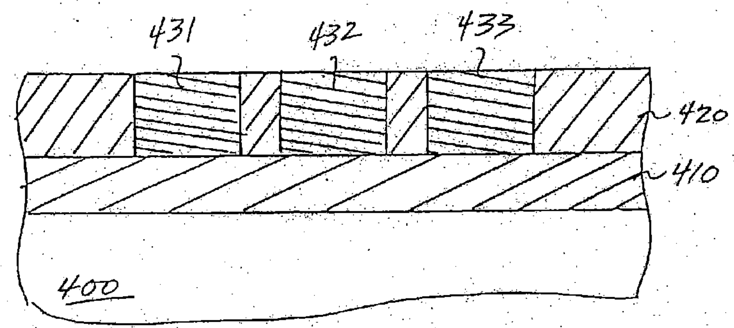

FIG. 10

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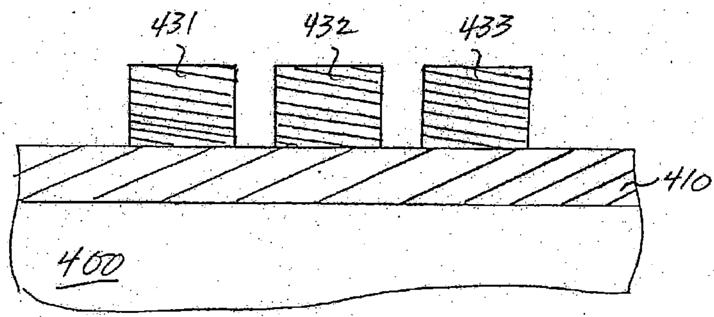

FIG. 11

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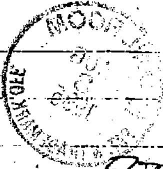

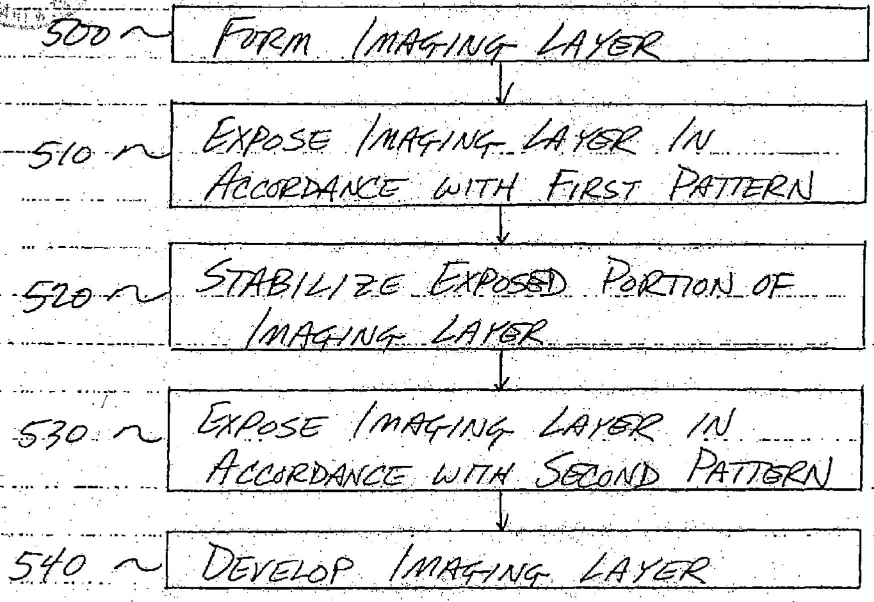

FIG. 12

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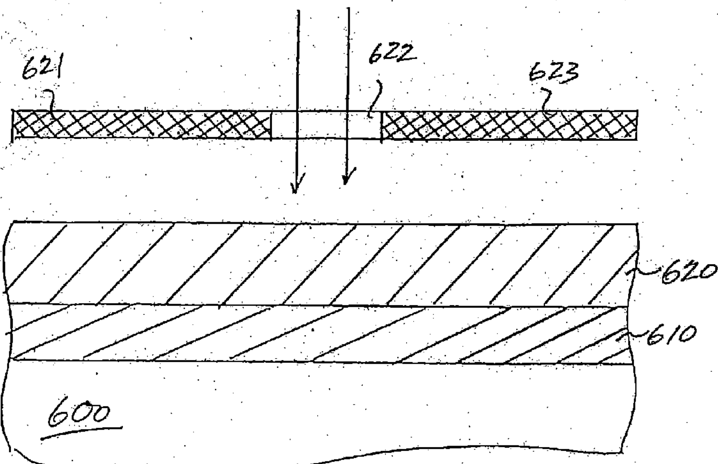

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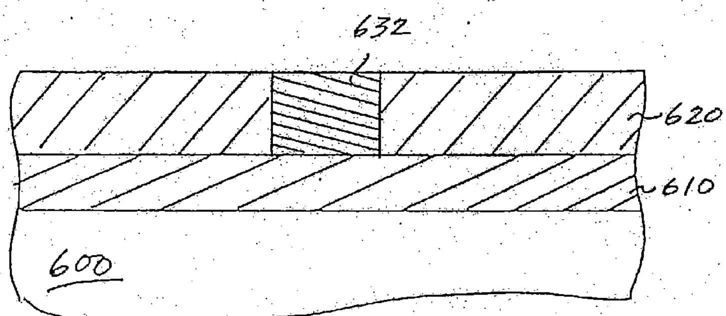

FIG. 14

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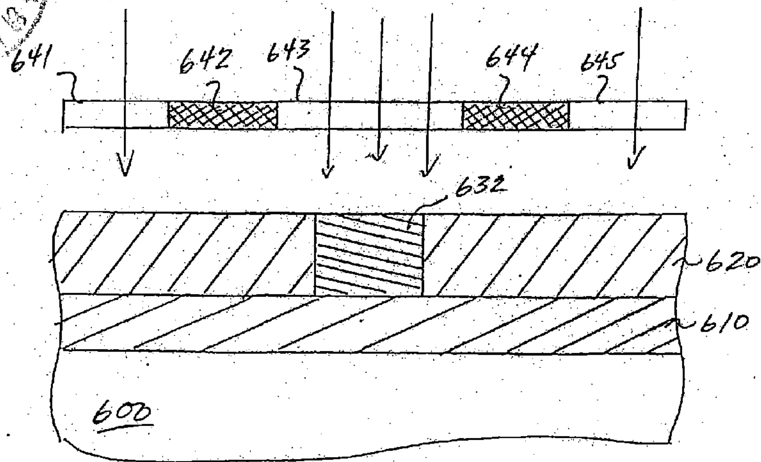

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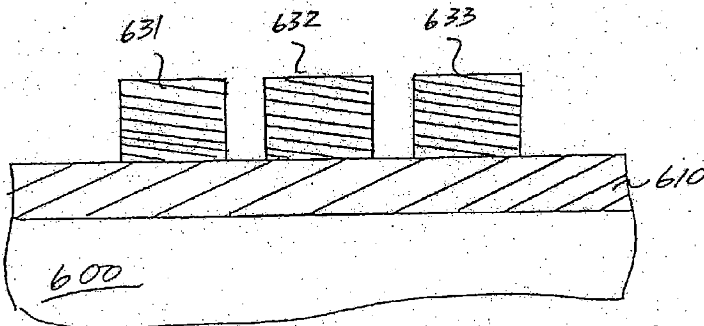

FIG. 16

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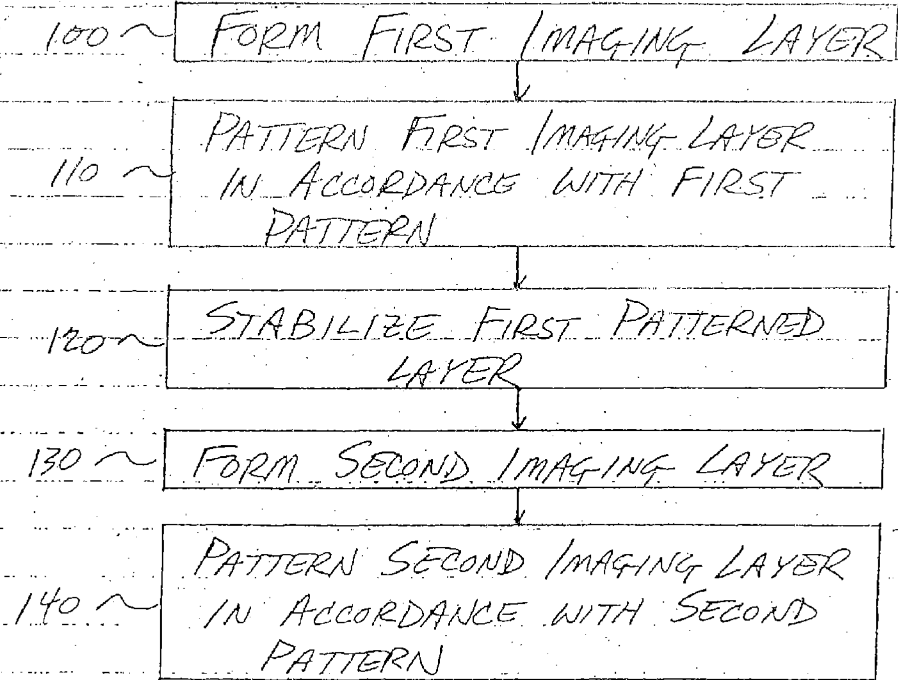

FIG. 1

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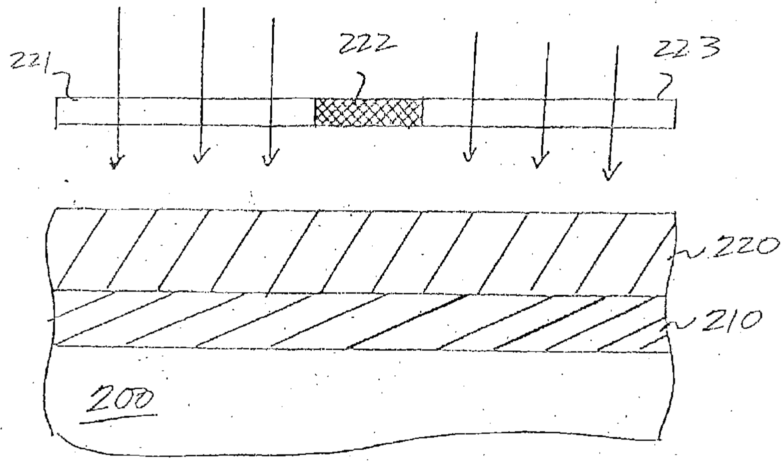

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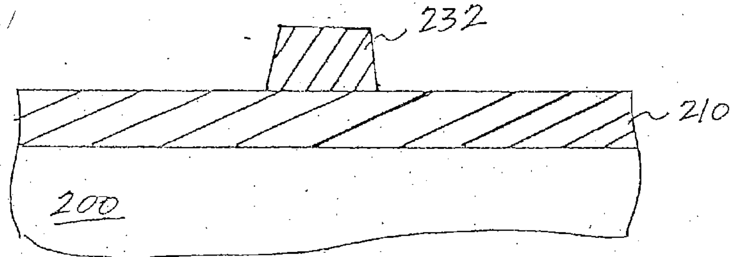

FIG. 3

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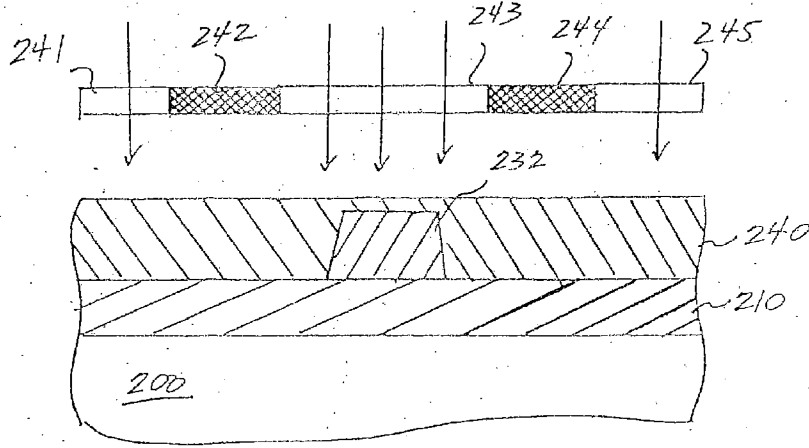

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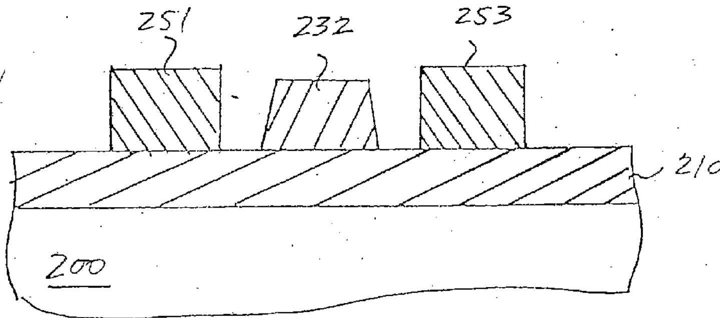

FIG. 5

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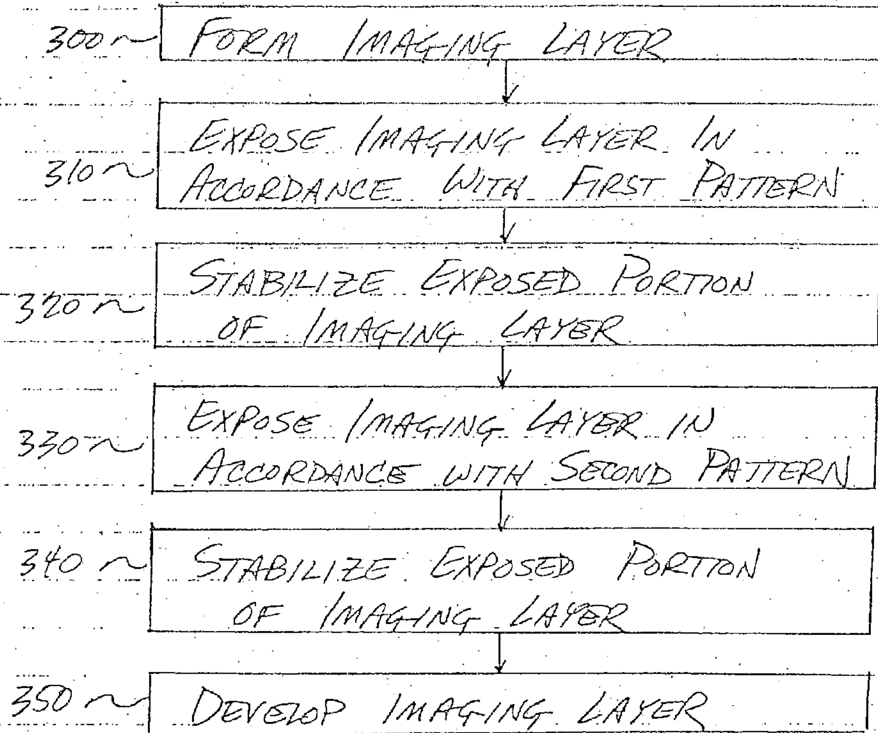

FIG. 6

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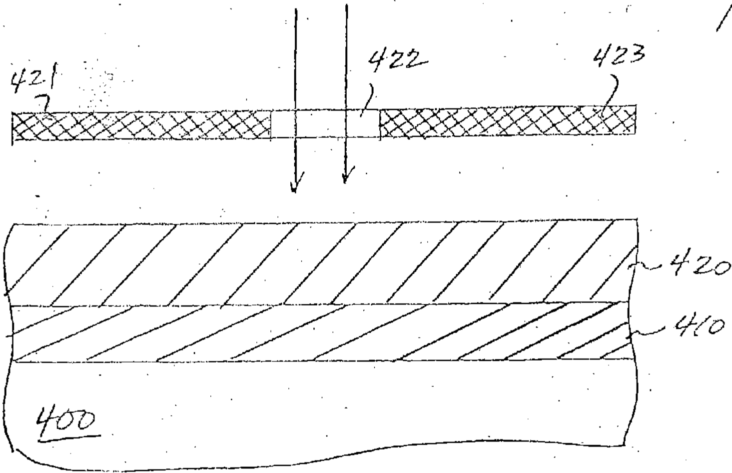

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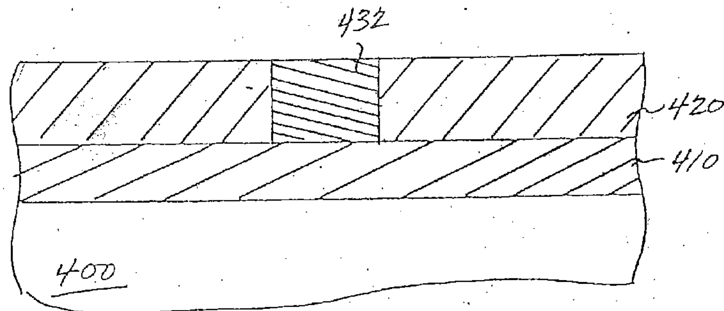

FIG. 8

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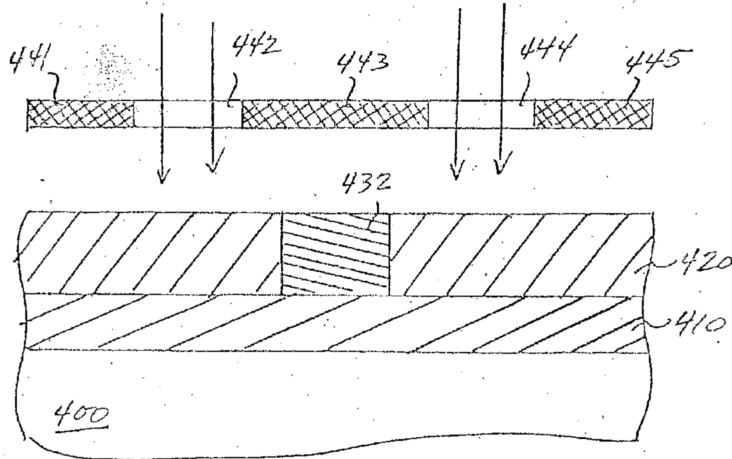

FIG. 9

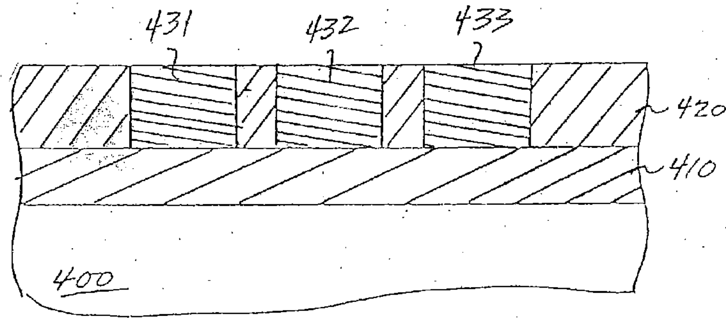

FIG. 10

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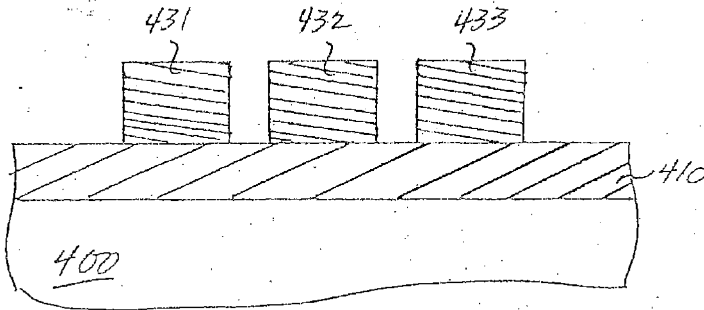

FIG. 11

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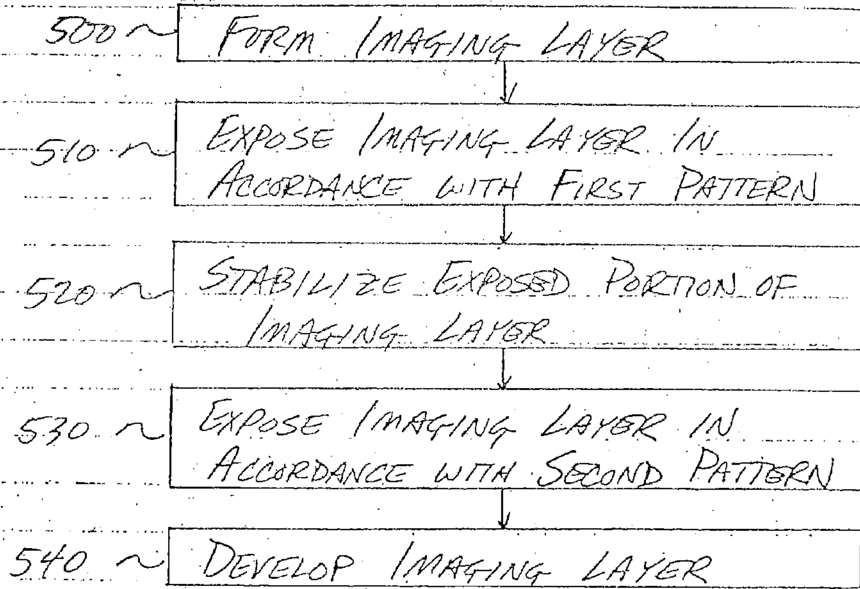

FIG. 12

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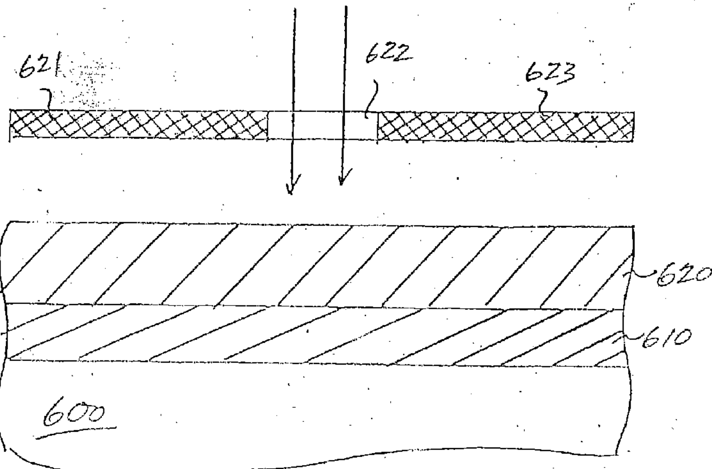

FIG. 13

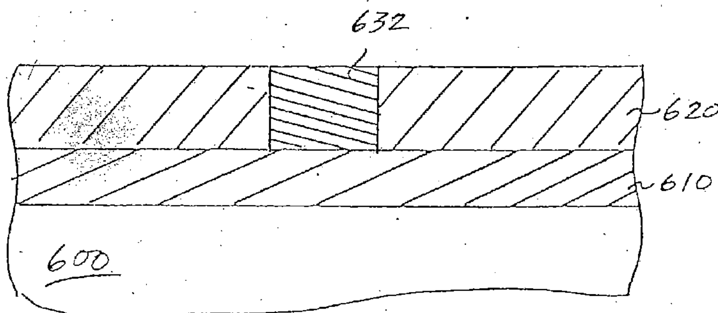

FIG. 14

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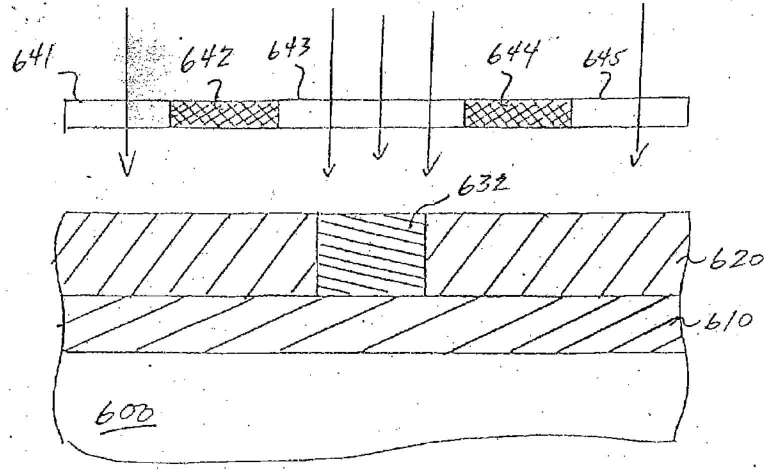

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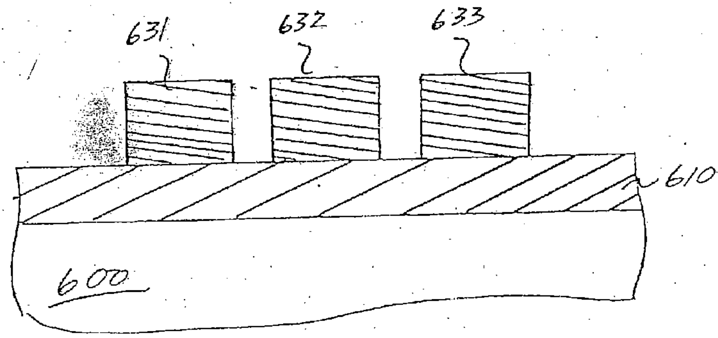

FIG. 16

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16?? 048D — Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	
James M. Cleeves	Examiner: Duda, K.
Serial No.:	Art Unit: 1507
Filing Date:	
For: METHOD FOR REDUCED PITCH LITHOGRAPHY	

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

INFORMATION DISCLOSURE STATEMENT

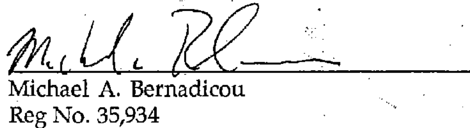
Dear Commissioner:

Enclosed is a copy of Information Disclosure Citation Form PTO-1449, submitted pursuant to 37.C.F.R. §1.56, together with the cited prior art on that form. This is a Divisional of application serial no. 08/361,595, filed December 22, 1994. It is respectfully requested that the cited document(s) be considered and the enclosed copy of Information Disclosure Statement (IDS) form PTO 1449 be initialed by the Examiner to indicate such consideration and a copy thereof returned to Applicant.

The Commissioner is hereby authorized to charge payment of any processing fees under 37 C.F.R. §1.17 to Deposit Account No. 02-2226. A duplicate copy of this information disclosure statement is enclosed for deposit acount charging purposes.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 8/3/95



Michael A. Bernadicou
Reg No. 35,934

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

EXPRESS MAIL MAILING CERTIFICATE

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8-3-95

Name: Alice Yam — Date.

Sheet 1 of 2

Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.: 16820.P048D

SERIAL NO. 740014 ~~08/510717~~

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

APPLICANT: James M. Cleeves

FILING DATE: 8/3/95

GROUP: 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
KMD		4548688	10/15/85	Matthews	204	159.18	5/23/83
		4826756	5/15/89	Orvek	430	328	7/1/87
		4904866	2/15/90	Collins et al.	250	492.2	11/17/88
		4931351	6/15/90	McColgin et al.	430	323	7/13/89
		5300403	4/15/94	Angelopolus et al.	430	325	6/18/92
KMD		4908656	3/15/90	Suwa et al.	355	53	1/15/89

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).
		"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).
		"Multilayer Circuit Fabrication Using Double Exposure of Positive Resist," IBM Technical Disclosure Bulletin, Vol. 36, No. 10, pp. 423-424 (October 1993).

EXAMINER: K. Duda

DATE CONSIDERED: 11-27-95

*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.

Sheet 2 of 2

Form PTO-1449 (REV. 8-83) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 16820.P048D	SERIAL NO. 740014 ~~08/510777~~
INFORMATION DISCLOSURE CITATION	APPLICANT James M. Cleeves	
(Use several sheets if necessary)	FILING DATE 8/3/95	GROUP 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.)*

KMD		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	11-27-95

*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.

$730.00 101 A 08/510717

Attorney's Docket No.: 16820.P048D

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

Prior Application:
Examiner: Duda, K.
Art Unit: 1507

RULE 60

SIR: This is a request for filing a

_____ Continuation application   X Divisional application

under 37 C.F.R. § 1.60 of pending prior application serial 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. **Enclosed is a complete copy of the prior application including the specification (including claims), the oath or declaration showing the signature or an indication that it was signed, and any amendment referred to in the oath or declaration filed to complete the application. (See below for drawing requirements.) I hereby verify that the attached papers are a true copy of the prior application serial no. 08/361,595 as originally filed on December 22, 1994.**

X 2. **Copies of the drawings filed in the prior application are enclosed herewith.**

_____ 3. Transfer the drawings from the prior application and **abandon** said prior application as of the filing date accorded this application. A duplicate copy of this sheet is enclosed for filing in the prior application file. (May only be used if signed by person authorized by 37 C.F.R. § 1.138 and before payment of base issue fee.)

_____ 4. New formal drawings are enclosed.

X 5. The filing fee is calculated below:

CLAIMS AS FILED IN THE PRIOR APPLICATION LESS ANY CLAIMS CANCELED BY AMENDMENT 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:	11	- 20	* -0-	x 11	$	x 22	$ -0-
Indep. Claims:	1	-3	* -0-	x 38	$	x 76	$ -0-
Multiple Dependent Claim(s) Presented				+120	$	+240	$ -0-
				TOTAL	$ -0-	TOTAL	$ -0-

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

"Express Mail" mailing label number TB907642373US

Date of Deposit 8-3-95

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

Alice Tam
(Typed or printed name of person mailing paper or fee)

[signature]
(Signature of person mailing paper or fee)

LJV/wes/cak (10/01/94) Rule 60

_____ 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 prior application **and such status is still proper and desired.** 37 C.F.R. § 1.28(a).

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

_X_ 8. A check in the amount of $ 730.00 is enclosed for the filing fee.

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

_X_ 10. Cancel in this application original claims 1-11 of the prior application before calculating the filing fee (wherein at least one independent claim is retained for filing purposes).

_____ 11. A preliminary amendment is enclosed. (Claims added by this amendment should be numbered consecutively beginning with the number next following the highest numbered original claim in the prior application. Only an amendment reducing the number of claims or adding a reference to the prior application will be entered before calculating the filing fee and granting the filing date.)

_X_ 12. Amend the specification by inserting the following before the first sentence on the first page:

_X_ (a) -- ~~This is~~ a ________ continuation/ X divisional of application serial no. 08/361,595, filed December 22, 1994. --

_____ (b) --, which is a ________ continuation/________ divisional of application serial no. ____________________, filed ____________________ . --
(list all prior applications)

_X_ 13. It is hereby requested that any request for a convention priority made in the prior application be transferred to this Rule 60 application.

_____ 14. The prior application is assigned of record to:

_X_ 15. The Power of Attorney in the prior application is to:

(Name) (Reg. No.)
Edwin H Taylor, Reg. No. 25,129, and certain other listed attorneys or agents of:
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN
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 serial no. 08/361,595 filed December 22, 1994.

_____ (b) Because the Power does not appear in the original papers, a copy of the Power in the prior application is enclosed.

_____ (c) Recognize as an associate attorney or agent and address all future communications to:

(Name) (Reg. No.)
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN
12400 Wilshire Blvd., Seventh Floor
Los Angeles, California 90025
(408) 720-8598

_____ (d) Address all future communications to the undersigned.

29

_______ 16. **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__ 17. Applicant(s) hereby petition(s) for an extension of time pursuant to Rule 1.136, if needed, for the above-noted prior application. The 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.

_______ 18. Accompanying this application is a statement requesting deletion of the name(s) of the person or persons who are not inventors of the invention being claimed in the continuation/divisional application. 37 C.F.R § 1.60(b).

The undersigned declares further that all statements made herein of his or her 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 issuing thereon.

Respectfully submitted,

BLAKELY SOKOLOFF TAYLOR & ZAFMAN

Date: 8/3/95

By Michael A. Bernadicou

Reg. No. 35,934

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

__X__ Attorney or Agent of Record

_______ 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 INVENTOR		ATTORNEY DOCKET NO.
08/510,717	08/03/95	CLEEVES	J	16820.P048D

EXAMINER: ~~DUDA, K~~

15N2/1128

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

ART UNIT	PAPER NUMBER
1113	4

DATE MAILED: 11/28/95

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 12-22 are pending in the application.

   Of the above, claims ______ are withdrawn from consideration.

2. ☒ Claims 1-11 have been cancelled.
3. ☐ Claims ______ are allowed.
4. ☒ Claims 12-22 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

1. Claims 12-22 are pending in this application.

Claim Rejections - 35 USC § 112

2. Claim 12 is rejected under 35 U.S.C. § 112, first paragraph, as the disclosure is enabling only for claims limited to a positive resist. See M.P.E.P. §§ 706.03(n) and 706.03(z).

Claim 13 recites the limitation that the photoresist is a positive photoresist. The independent claim should make this recitation since the invention is only enabled for a positive photoresist.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

4. Claims 12-22 are rejected under 35 U.S.C. § 102(a) as being clearly anticipated by Haragucji (US Patent 5,320,932).

Haraguchi teaches a process of patterning whereby a positive photoresist is exposed through a mask. The resist is then exposed to an ammonia/heating process followed by a second patterning step (see column 4, lines 26 to 64).

Claim Rejections - 35 USC § 103

5. 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.

6. Claims 12-22 are rejected under 35 U.S.C. § 103 as being unpatentable over Tsuji (US Patent 4,985,374).

Tsuji teaches a process of patterning whereby a positive resist is applied to a substrate. The resist layer is exposed to form two regions. The resist is then heated in an ammonia environment before exposing to a pattern to form another exposed region. Further processing of the layer then occurs.

Therefore, it would have been obvious to one of skill in the art to have used an ammonia/heat step between two exposure steps because Tsuji teaches such a process in the manufacture of semiconductor device.

7. Claims 12-22 are rejected under 35 U.S.C. § 103 as being unpatentable over Maheras (US Patent 4,859,573).

Maheras teaches a patterning process wherbey a resist is exposed through a portion of the layer and then selectively hardened. A second exposure then occurs which exposes throughout the thickness.

Therefore, it would have been obvious to have exposed an imaging layer twice with a stablizing step in between because Maheras teaches such a process. The claims of the present invention do not clarify if the second exposure is a different pattern than the first exposure pattern.

Conclusion

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

McFarland (US Patent 4,775,609) and Ziger (US Patent 4,814,243) teach image reversal processes using an ammonia/heat process. A second flood exposure is taught not a patterning step.

9. Any inquiry concerning this communication should be directed to Examiner K. Duda at telephone number (703) 308-2292 or by FAX at (703) 305-5433. Any general questions can be directed to the receptionist at (703) 308-2351.

kad
11-27-95

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

Notice of References Cited	Application No. 08/510,717 740014	Applicant(s) Cleeves	
	Examiner Kathleen Duda	Group Art Unit 1113	Page 1 of 1

U.S. PATENT DOCUMENTS

	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
A	4,775,609	10/1988	McFarland	430	394
B	4,814,243	3/1989	Ziger	430	394
C	4,859,573	8/1989	Maheras	430	394
D	4,985,374	1/1991	Tsuji	430	312
E	5,320,932	6/1994	Haraguchi	430	394
F					
G					
H					
I					
J					
K					
L					
M					

FOREIGN PATENT DOCUMENTS

	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS

	DOCUMENT (Including Author, Title, Source, and Pertinent Pages)	DATE
U		
V		
W		
X		

Attorney's Docket No.: 16820.P048D

Patent

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

Application No.: 08/510,717

Filed: August 3, 1995

For: METHOD FOR REDUCED PITCH LITHOGRAPHY (title)

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.
X 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	* 16	Minus	** 20	0	x11	$	x22	$ -0-
Indep. Claims	* 3	Minus	*** 3	0	x39	$	x78	$ -0-
	First Presentation of Multiple Dependent Claim(s)				+125	$	+250	$
					Total Add. Fee	$	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 claims.
____ Applicants hereby Petition for an Extension of Time of ______monthS 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.

Respectfully Submitted,
BLAKELY SOKOLOFF TAYLOR & ZAFMAN

[signature]
Roland B. Cortes

Reg. No. 39,152

Date: February 28, 1996

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(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 Commissioner of Patents and Trademarks, Washington, D.C. 20231

on February 28, 1996
Date of Deposit

Dulcie G. Stinson
Name of Person Mailing Correspondence

Dulcie G. Stinson — Signature
February 28, 1996 — Date

(LJV/oak 10/02/95)

Attorney's Docket No.: 16820.P048D — Patent

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

Application No.: 08/510,717

Filed: August 3, 1995

For: METHOD FOR REDUCED PITCH LITHOGRAPHY (title)

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.

X 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	* 16	Minus	** 20	0	x11	$	x22	$ -0-
Indep. Claims	* 3	Minus	*** 3	0	x39	$	x78	$ -0-
First Presentation of Multiple Dependent Claim(s)					+125	$	+250	$
					Total Add. Fee	$	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 claims.

_____ Applicants hereby Petition for an Extension of Time of _____ monthS 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.

Respectfully Submitted,
BLAKELY SOKOLOFF TAYLOR & ZAFMAN

Date: February 28, 1996

[signature]
Roland B. Cortes

Reg. No. 39,152

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(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 Commissioner of Patents and Trademarks, Washington, D.C. 20231

on February 28, 1996
Date of Deposit

Dulcie G. Stinson
Name of Person Mailing Correspondence

Dulcie G. Stinson — February 28, 1996
Signature — Date

(LJV/cak 10/02/95)

Our Docket No.: 16820.P048D

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

#5/B
3-22-96
HP

In re Application of:

James M. Cleeves

Serial No.: 08/510,717

Filed: August 3, 1995

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Group: 1113

GROUP 110 MAR 13 PM 1:50 RECEIVED

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 November 28, 1995, please amend the above-identified application and consider the following remarks.

IN THE SPECIFICATION

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

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

IN THE CLAIMS

Please amend Claim 12.

Please add new Claim 23 - 28.

1 12. (Amended) A lithography method for semiconductor fabrication using a
2 semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a portion of the imaging layer to radiation in accordance
5 with a first pattern;
6 (c) stabilizing the exposed portion of the imaging layer; and
7 (d) patterning the imaging layer in accordance with a second pattern to
8 form a patterned layer, said second pattern being different than said first pattern,
9 wherein the patterned layer has adjacent features which are formed relatively
10 closer to one another than is possible through a single exposure to radiation.

SUB B1

B1

1 23. (New) The lithography method of Claim 12, wherein said adjacent
2 features comprise a plurality of disposable posts.

SUB B3

B2

1 24. (New) The lithography method of Claim 12, wherein said adjacent
2 features have a pitch which is not limited by a single exposure to radiation.

1 25. (New) A lithography method for semiconductor fabrication using a
2 semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a first portion of the imaging layer to radiation in
5 accordance with a first pattern;
6 (c) stabilizing the exposed first portion of the imaging layer;
7 (d) exposing a second portion of the imaging layer in accordance with a
8 second pattern, wherein said second pattern is different than said first pattern;
9 (e) stabilizing the exposed second portion of the imaging layer; and
10 (f) developing the imaging layer to form a patterned layer.

1 26. (New) The lithography method of Claim 25, wherein the patterned
2 layer has adjacent features which are formed relatively closer to one another
3 than is possible through a single exposure to radiation.

1 27. (New) The lithography method of Claim 25, wherein the patterned
2 layer comprises a plurality of disposable posts, each disposable post being formed
3 relatively closer to other disposable posts than is possible through a single
4 exposure to radiation.

1 28. (New) The lithography method of Claim 25, wherein the patterned
2 layer has adjacent features, the adjacent features having a pitch which is not
3 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. Rejection of Claim 12 under 35 U.S.C. §112, first paragraph.

The Office Action dated November 25, 1995 rejected Claim 12 under 35 U.S.C. §112, first paragraph because the disclosure is enabling only for positive photoresist. Applicant traverses the rejection.

It will be appreciated by one skilled in the art that other suitable radiation-sensitive materials may be used for the imaging layer of Claim 12 (specification page 15, lines 5-6, and page 20, lines 12-13). For example, the imaging layer may include a suitable negative-tone radiation-sensitive polyimide (specification page 20, lines 1-3). Moreover, it will be appreciated by one skilled in the art that a negative resist may also be used for the imaging layer.

II. Rejection of Claims 12-22 under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 5,320,932 issued to Haraguchi et al.

The Office Action rejected Claims 12-22 under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 5,320,932 issued to Haraguchi et al. Applicant responds as follows.

A. Claims 12-22 and New Claims 23 and 24.

Haraguchi et al. does not disclose each and every element of Claim 12 as presently amended. First, Haraguchi et al. does not disclose exposing a first portion of an imaging layer to radiation in accordance with a first pattern, and patterning the imaging layer in accordance with a second pattern to form a

patterned layer. In contrast to Claim 12 of the present invention, Haraguchi et al. discloses only one pattern which is not formed from a first and second pattern. Given that Haraguchi et al. only discloses one pattern, it further does not disclose, as claimed in presently amended Claim 12, that "said second pattern being different than said first pattern."

Second, Haraguchi et al. does not disclose that a patterned layer formed from a first and second pattern has adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. Additionally, Haraguchi et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 23. Moreover, Haraguchi et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 24.

Therefore, since Haraguchi et al. does not disclose each and every element of presently amended Claim 12, Applicant respectfully requests the removal of the rejection under 35 U.S.C. §102(a) and submits that Claim 12 is in condition for allowance. Additionally, Applicant respectfully submits that since Claim 13-24 depend upon Claim 12, that the rejection to Claims 13-22 also be removed and that Claims 13-24 are in condition for allowance.

B. New Claims 25 - 28

Haraguchi et al. does not disclose each and every element of new independent Claim 25. First, Haraguchi et al. does not disclose exposing a first portion of an imaging layer to radiation in accordance with a first pattern, and patterning the imaging layer in accordance with a second pattern, the imaging layer then being developed to form a patterned layer. In contrast to Claim 25 of the present invention, Haraguchi et al. discloses only one pattern which is not

formed from a first and second pattern. Given that Haraguchi et al. only discloses one pattern, it further does not disclose, as claimed in new Claim 25, that "said second pattern is different than said first pattern."

Second, Haraguchi et al. does not disclose two stabilizing steps. That is, Haraguchi et al. does not disclose stabilizing an exposed first portion of an imaging layer, and stabilizing an exposed second portion of the imaging layer.

Third, Haraguchi et al. does not disclose, as claimed in new Claim 26, that a patterned layer formed from a first and second pattern further has adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. Additionally, Haraguchi et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Moreover, Haraguchi et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 28.

Therefore, since Haraguchi et al. does not disclose each and every element of new Claim 25, Applicant respectfully submits that new Claim 25 is in condition for allowance. Additionally, Applicant respectfully submits that since Claim 26 - 28 depend upon Claim 25, that Claims 26 - 28 are in condition for allowance.

III. Rejection of Claims 12-22 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 4,985,374 issued to Tsuji et al.

The Office Action rejected Claims 12-22 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 4,985,374 issued to Tsuji et al. Applicant responds as follows.

A. Claims 12-22 and New Claims 23 and 24.

Claim 12, as presently amended, would not have been obvious at the time the present invention was made in view of Tsuji et al. Tsuji et al. does not teach, suggest, or disclose each and every element of Claim 12 as presently amended, nor does any other reference provide these missing elements. Tsuji et al. does not disclose that a patterned layer formed from a first and second pattern has adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. Additionally, Tsuji et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 23. Moreover, Tsuji et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 24. Tsuji et al. attempts to provide a method for simultaneously forming an opening having a sufficient coverage and positioning marks (column 2, lines 38-42). There is nothing taught, suggested, or described in Tsuji et al. that would motivate one skilled in the art to arrive at the lithography method of presently amended Claim 12 or new Claims 23 and 24.

Therefore, Applicant respectfully requests the removal of the rejection under 35 U.S.C. §103 and submits that Claim 12 is in condition for allowance. Additionally, Applicant respectfully submits that since Claim 13-24 depend upon Claim 12, that the rejection to Claims 13-22 also be removed and that Claims 13-24 are in condition for allowance.

B. New Claims 25 - 28.

New independent Claim 25 would not have been obvious at the time the present invention was made in view of Tsuji et al. Tsuji et al. does not teach, suggest, or disclose each and every element of Claim 25 as presently amended,

nor does any other reference provide these missing elements. Tsuji et al. does not teach, disclose, or suggest stabilizing an exposed first portion of an imaging layer, and stabilizing an exposed second portion of the imaging layer. Tsuji et al. attempts to provide a method for simultaneously forming an opening having a sufficient coverage and positioning marks (column 2, lines 38-42). There is nothing taught, suggested, or described in Tsuji et al. that would motivate one skilled in the art to arrive at the lithography method of new Claim 25.

Additionally, Tsuji et al. does not disclose, as claimed in new Claim 26, that a patterned layer formed from a first and second pattern further has adjacent features which are formed relatively closer to one another than is possible through a single exposure to radiation. Moreover, Tsuji et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Furthermore, Tsuji et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 28.

Therefore, since Tsuji et al. does not disclose each and every element of new Claim 25, Applicant respectfully submits that new Claim 25 is in condition for allowance. Additionally, Applicant respectfully submits that since Claim 26 - 28 depend upon Claim 25, that Claims 26 - 28 are in condition for allowance.

IV. Rejection of Claims 12-22 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 4,859,573 issued to Maheras et al.

The Office Action rejected Claims 12-22 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 4,859,573 issued to Maheras et al. Applicant responds as follows.

A. Claims 12-22 and New Claims 23 and 24.

Claim 12, as presently amended, would not have been obvious at the time the present invention was made in view of Maheras et al. Maheras et al. does not teach, suggest, or disclose each and every element of Claim 12 as presently amended, nor does any other reference provide these missing elements. Maheras et al. does not disclose that a patterned layer formed from a first and second pattern, which are different, has 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 Figures 3A - 3D of Maheras et al. disclose a single patterned layer not formed from a first and second patterned layer. Additionally, it is Applicant's understanding that Figures 1A - 1D of Maheras et al. disclose a thin and thick resist layer which, in contrast to the present invention claimed in presently amended Claim 12, do not have features which are formed relatively closer to one another than is possible through a single exposure to radiation. Moreover, Maheras et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 23. Furthermore, Maheras et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 24.

Additionally, Maheras et al. does not disclose stabilizing the exposed portion of the imaging layer as claimed in step (c) of Claim 12 of the present invention; rather, Maheras et al. discloses surface hardening the unexposed areas of photoresist (column 6, lines 36-64). There is nothing taught, suggested, or described in Maheras et al. that would motivate one skilled in the art to arrive at the lithography method of presently amended Claim 12.

Therefore, Applicant respectfully requests the removal of the rejection under 35 U.S.C. §103 and submits that Claim 12 is in condition for allowance. Additionally, Applicant respectfully submits that since Claim 13-24 depend upon Claim 12, that the rejection to Claims 13-22 also be removed and that Claims 13-24 are in condition for allowance.

B. New Claims 25 - 28.

New independent Claim 25 would not have been obvious at the time the present invention was made in view of Maheras et al. Maheras et al. does not teach, suggest, or disclose each and every element of Claim 23 as presently amended, nor does any other reference provide these missing elements.

Maheras et al. does not disclose stabilizing the exposed first portion of the first imaging layer, nor stabilizing the exposed second portion of the imaging layer as claimed in Claim 25; rather, Maheras et al. discloses surface hardening the unexposed areas of photoresist (column 6, lines 36-64). There is nothing taught, suggested, or described in Maheras et al. that would motivate one skilled in the art to arrive at the lithography method of new Claim 25.

Moreover, Maheras et al. does not teach, disclose, or suggest stabilizing an exposed first portion of an imaging layer, and stabilizing an exposed second portion of the imaging layer as claimed in new Claim 25.

Additionally, Maheras et al. does not disclose, as claimed in new Claim 26, that a patterned layer formed from a first and second pattern, which are different, has 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 Figures 3A - 3D of Maheras et al. disclose a single patterned layer not formed

from a first and second patterned layer. Additionally, it is Applicant's understanding that Figures 1A - 1D of Maheras et al. disclose a thin and thick resist layer which, in contrast to the present invention claimed in new Claim 26, do not have features which are formed relatively closer to one another than is possible through a single exposure to radiation. Moreover, Maheras et al. does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Furthermore, Maheras et al. does not disclose that the adjacent features have a pitch which is not limited by a single exposure to radiation as claimed in new Claim 28.

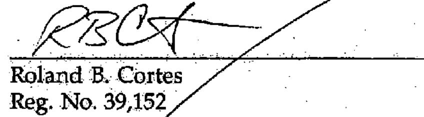
Therefore, Applicant respectfully submits that new Claim 25 is in condition for allowance. Additionally, Applicant respectfully submits that since Claims 26 - 28 depend upon Claim 25, that Claims 26 - 28 are in condition for allowance.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 12-28 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 28, 1996

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:

Dulcie Stinson February 28, 1996

Name : Dulcie Stinson *Date: February 28, 1996*

220-126 GP1113

Attorney's Docket No. 016820.P048D PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of:	)	
James M. Cleeves	)	Examiner: Duda, K.
Application No.: 08/510,717	)	Art Unit: 1113 X
Filed: August 3, 1995	)	
For: METHOD FOR REDUCED PITCH LITHOGRAPHY	)	

#6 5-5-96 HP

RECEIVED APR 2 1 1996 GROUP 1100

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:

020 JH 04/24/96 08510717 1 126 220.00 CK

____ 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: April 16, 1996

RBC [signature]
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:

April 16, 1996
Date of Deposit

Dulcie G. Stinson [signature] 4/16/96
Name: Dulcie G. Stinson Date

#6

Sheet 1 of 3

Form PTO-1449 (REV. 8-83)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO. 16820.P048D

SERIAL NO. 740014 ~~08/510,717~~

APPLICANT James M. Cleeves

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

FILING DATE 08/03/95

GROUP 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
KMD	AA	5270236	12/14/93	Rosner	437	48	
↓	AB	5158910	10/27/92	Cooper et al.	437	195	
↓	AC	5219787	06/15/93	Carey et al.	437	187	
↓	AD	5319247	06/07/94	Matsuura	257	760	
KMD	AE	5352630	10/04/94	Kim et al.	437	195	
	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.)*

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 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 K. Duda

DATE CONSIDERED 5-26-96

*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.

Sheet 2 of 3

Form PTO-1449 (REV. 8-83)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 16820.P048D	SERIAL NO. 740014 ~~08/510,717~~
INFORMATION DISCLOSURE CITATION		APPLICANT James M. Cleeves	
(Use several sheets if necessary)		FILING DATE 08/03/95	GROUP 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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	AL							
	AM							
	AN							
	AO							
	AP							

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

KMD		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.
KMD		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.
KMD		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.
KMD		"Method for Forming Via Hole Formation", IBM Technical Disclosure Bulletin, Vol. 34, No. 10A, March 1992, pp. 219-220.
KMD		"Self-Aligned, Borderless Polysilicon Contacts Using Polysilicon Pillars", IBM Technical Disclosure Bulletin, Vol. 35, No. 2, July 1992, pp. 480-483.

EXAMINER	DATE CONSIDERED
K. Duda	5-26-96

*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.

Sheet 3 of 3

Form PTO-1449 (REV. 8-83) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 16820.P048D	SERIAL NO. 740014 ~~08/510,717~~
INFORMATION DISCLOSURE CITATION	APPLICANT James M. Cleeves	
(Use several sheets if necessary)	FILING DATE 08/03/95	GROUP 1113

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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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	5-26-96

*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 INVENTOR	ATTORNEY DOCKET NO.
08/510,717	08/03/95	CLEEVES	J 16820.P048D

EXAMINER: DUDA,K

11M1/0528

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

ART UNIT	PAPER NUMBER
1113	7

DATE MAILED: 05/28/96

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 3/5/96 & 4/19/96 ☒ 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. (3)
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 12-28 are pending in the application.

   Of the above, claims ______ are withdrawn from consideration.

2. ☐ Claims ______ have been cancelled.
3. ☐ Claims ______ are allowed.
4. ☒ Claims 12-28 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)

1. Claims 12-28 are pending in this application.

Specification

2. The following is a quotation of the first paragraph of 35 U.S.C. § 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification is objected to under 35 U.S.C. § 112, first paragraph, as the specification, as originally filed, does not support the invention as is now claimed.

Support could not be found in the specification for the recitation in the claims of a second stabilization step.

Support could not be found for the recitation that the first pattern is different from the second pattern.

Claim Rejections - 35 USC § 112

3. Claims 25-28 are rejected under 35 U.S.C. § 112, first paragraph, for the reasons set forth in the objection to the specification.

<u>Claim Rejections - 35 USC § 102</u>

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

5. Claims 12-22 are rejected under 35 U.S.C. § 102(a) as being clearly anticipated by Haragucji (US Patent 5,320,932).

Haragucji teaches a process of patterning whereby a positive photoresist is exposed through a mask. The resist is then exposed to an ammonia/heating process followed by a second patterning step (see column 4, lines 26 to 64).

Applicant argues that Haragucji does not teach exposing with a first and second pattern with the second pattern being different from the first. Column 3, lines 28-30 teach that after the conversion step "selected portions of the resist layer are exposed to light". This appears to be a patterning step since selected areas are being exposed.

Applicant argues that Haragucji does not teach that the patterns are close to one another. Column 5, lines 47-51, teach that the resist layer is formed once and the desired patterns are formed as designed.

Claim Rejections - 35 USC § 103

6. 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.

7. Claims 23-28 are rejected under 35 U.S.C. § 103 as being unpatentable over Haragucji (US Patent 5,320,932).

The teachings of Haragucji have been discussed above. It would have been obvious to have added another stabilization step after another exposure step depending on the pattern desired and the type of photoresist used. It would have been obvious to have some of the features be posts as claimed because that is a design choice.

8. Claims 12-28 are rejected under 35 U.S.C. § 103 as being unpatentable over Tsuji (US Patent 4,985,374).

Tsuji teaches a process of patterning whereby a positive resist is applied to a substrate. The resist layer is exposed to form two regions. The resist is then heated in an ammonia environment before exposing to a pattern to form another exposed region. Further processing of the layer then occurs.

Therefore, it would have been obvious to one of skill in the art to have used an ammonia/heat step between two exposure steps because Tsuji teaches such a process in the manufacture of semiconductor devices.

Applicant argues that Tsuji does not disclose that features are closer together. Tsuji teaches that the method leads to high accuracy. A method does not have to have the same purpose to be obvious.

Applicant argues that Tsuji does not disclose posts as the features. This is a design choice.

Conclusion

9. Applicant's amendment necessitated the new grounds of rejection. Accordingly, **THIS ACTION IS MADE FINAL.** See M.P.E.P. § 706.07(a). 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

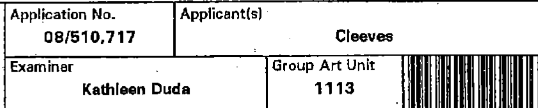
IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. § 1.136(a) WILL BE CALCULATED FROM THE MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

10. 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
5-26-96

Interview Summary



Application No.	Applicant(s)
08/510,717	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: *12 and 25*

Identification of prior art discussed:
Haragucji and Tsuji

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 amendments to the claims to clarify and discussed the prior art relative to the claims. 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

Attorney's Docket No.: 16820.P048D

PATENT

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

Serial No: 08/510,717

Filed: 8/3/95

For: Method For Reduced Pitch Lithography (title)

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

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:	18	minus	22	0	x $11.00=	$0.00	x $22.00=	$0.00
Indep. Claims:	2	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

[signature]
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 deposited with the United States Postal Service as First Class mail with sufficient postage in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on:

September 24, 1996

[signature] 9/24/96
Dulcie G. Stinson — Date

LJV/ccm (01/31/96)

Attorney's Docket No.: 16820.P048D

PATENT

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

Appln. No: 08/510,717

Filed: 8/3/95

For: Method For Reduced Pitch Lithography (title)

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

RECEIVED
OCT 5 1996
GROUP 1100

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:	18	minus	22	0	x $11.00=	$0.00	x $22.00=	$0.00
Indep. Claims:	2	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 [signature]

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 deposited with the United States Postal Service as First Class mail with sufficient postage in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on:

September 24, 1996

Dulcie G. Stinson 9/24/96

Dulcie G. Stinson *Date*

LJV/ccm (01/31/96)

110°-115

GP 1113X

Attorney Docket No.: 16820.P048D

Patent

#8/Ext.

m. Watts 10/9/96

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED

OCT 5 1996

GROUP 1100

In re Application of:

James M. Cleeves

Serial No.: 08/510,717

Filed: August 3, 1995

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

Examiner: Duda, K.

Art Group: 1113X

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 September 24, 1996
Date of Deposit

Dulcie G. Stinson
Name of Person Mailing Correspondence

Dulcie G. Stinson 9/24/96
Signature Date

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

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 May 28, 1996. The extended period expires on September 28, 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

RBC

Dated: September 24, 1996

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 08510717
1 115 110.00 CK

Attorney Docket No.: 16820.P048D | Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/510,717

Filed: August 3, 1995

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 September 24, 1996
Date of Deposit
Dulcie G. Johnson
Name of Person Mailing Correspondence
Dulcie G. Johnson 9/24/96
Signature Date

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

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 May 28, 1996. The extended period expires on September 28, 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 GP 1113 #9/Amdt C (N.E.) M. White 10/9/96

Attorney Docket No.: 16820.P048D Patent

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

Corres. and Mail BOX AF
RECEIVED
OCT 5 1996
GROUP 1100

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/510,717

Filed: August 3, 1995

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 September 24, 1996
Date of Deposit
Dulcie G. Shonson
Name of Person Mailing Correspondence
Dulcie G. Shonson 9/24/96
Signature Date

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 May 28, 1996, which was made final, Applicant submits this Amendment After Final Action for consideration.

IN THE CLAIMS

Please cancel claim 26.

Please amend claims 12, 20, 23, 24, 25, 27, and 28 as follows.

Do Not Enter 10/9/96 KAD

1 12. (Twice Amended) A lithography method for semiconductor fabrication
2 using a semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a portion of the imaging layer to radiation in accordance
5 with a first pattern to form a first feature;
6 (c) stabilizing the exposed portion of the imaging layer; and

IPR2014-01030 / TSMC-1018
Page 111 of 178

7 (d) patterning the imaging layer in accordance with a second pattern to
8 form a second feature distinct from the first feature, the first and second features
9 [to form] forming a patterned layer, [said second pattern being different than said
10 first pattern], wherein the [patterned layer has adjacent features which] the first
11 and second features are formed relatively closer to one another than is possible
12 through a single exposure to radiation.

1 20. (Once Amended) The method of claim 12, wherein the patterning step
2 (d) includes the steps of:
3 (i) exposing another portion of the imaging layer to radiation in
4 accordance with the second pattern,
5 (ii) stabilizing the exposed other portion of the imaging layer, and
6 [(iii) exposing the imaging layer to radiation, and]
7 (i[v]ii) developing the imaging layer to form the patterned layer.

1 23. (Once Amended) The lithography method of Claim 12, wherein said
2 [adjacent] first and second features comprise a plurality of disposable posts.

1 24. (Once Amended) The lithography method of Claim 12, wherein said
2 [adjacent] first and second features have a pitch which is not limited by a single
3 exposure to radiation.

1 25. (Once Amended) A lithography method for semiconductor fabrication
2 using a semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a first portion of the imaging layer to radiation in
5 accordance with a first pattern to form a first feature;

6 (c) stabilizing the exposed first portion of the imaging layer;

7 (d) exposing a second portion of the imaging layer in accordance with a

8 second pattern to form a second feature distinct from the first feature[, wherein

9 said second pattern is different than said first pattern];

10 (e) stabilizing the exposed second portion of the imaging layer; and

11 (f) developing the imaging layer to form a patterned layer, wherein the

12 first and second features are formed relatively closer to one another than is

13 possible through a single exposure to radiation.

1 27. (Once Amended) The lithography method of Claim 25, wherein the

2 [patterned layer comprises a plurality of] the first and second features comprise

3 disposable posts[, each disposable post being formed relatively closer to other

4 disposable posts than is possible through a single exposure to radiation].

1 28. (Once Amended) The lithography method of Claim 25, wherein the

2 [patterned layer has adjacent features, the adjacent] the first and second features

3 [having] have a pitch which is not limited by a single exposure to radiation.

Please add new claims 29 and 30.

1 29. (New) The lithography method of Claim 12, wherein the first and

2 second features do not overlap.

1 30. (New) The lithography method of Claim 25, where the first and

2 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.

Claim 26 has been canceled. Claims 12, 20, 23-25, 27, and 28 have been amended to better define the claimed invention. Support for the amendments to claims 12, 20, 23-25, 27, and 28 may be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. No new matter has been added.

New claims 29 and 30 have been added. Support for new claims 29 and 30 may also be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. No new matter has been added.

The rejection of claims 12-22 under 35 U.S.C. § 102 (a) as being anticipated by Haraguchi et al. ("Haraguchi") is respectfully traversed. Furthermore, the rejection of claims 23-28 under 35 U.S.C. § 103 as being unpatentable over Haraguchi is respectfully traversed.

Haraguchi discloses a method of forming contact holes in a semiconductor substrate and simultaneously in an electrode formed on the substrate. (column 1, lines 6-8). As illustrated in figure 3B of Haraguchi, photoresist layer 26 is exposed to ultraviolet light through mask 27 forming exposed portions 29 and unexposed portions 30_{11}, 30_{12}, and 30_{2} in layer 26. (see also column 4, lines 27-31). Figures 3C-3K illustrate that portions 30_{11}, 30_{12}, and 30_{2} are further processed in order to create contact holes 39_{1}, 39_{2}, and 40, respectively.

Haraguchi does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the imaging layer to form a

second feature distinct from the first feature. As described above, Haraguchi forms portions 301_1, 301_2, and 30_2 in response to a first exposure as illustrated in figure 3B, but does not form second features in layer 26 distinct from the first portions in subsequent processing steps. Therefore, Haraguchi does not anticipate the presently claimed invention.

Furthermore, Haraguchi cannot 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 Haraguchi does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the same imaging layer to form a second feature distinct from the first feature. 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 Haraguchi.

Consequently, the rejections of claims 12-22 and 23-28 are unsustainable and should be withdrawn.

The rejection of claims 12-28 under 35 U.S.C. § 103 as being unpatentable over Tsuji et al. ("Tsuji") is respectfully traversed.

Tsuji discloses two methods of forming a stepwise taper in a contact hole. (column 1, lines 7-13). Figures 4A-4G illustrate a first method of forming a stepwise taper. As illustrated in figures 4A of Tsuji, resist 13 is exposed to ultraviolet light through mask 16 forming unexposed regions 31 and 32. Regions 31 and 32 are then subjected to an image reversal process. (see also column 3, lines 61-63; and column 4, lines 12-40). Figure 4B then shows that a subsection 33 of region 31 is exposed to ultraviolet light. Figures 4C through 4G illustrate that

further processing steps expose and develop more of the area of region 31 in steps to create a stepwise taper including subsections 33, 34, and 35.

Figures 7A-7F illustrate a second method forming a stepwise taper in a contact hole. Figure 7B illustrates that resist 115 is exposed to ultraviolet light through masks 113 and 114 forming unexposed regions 131 and 132. Regions 131 and 132 are then subjected to an image reversal process. (see also, column 6, lines 7-32). Region 131 is then exposed and developed in figure 7C. Figures 7D-7E illustrate that the areas of insulating layer 111 immediately beneath regions 131 and 132 are subjected first to an isotropic etch and a dry etch to create a taper in insulating layer 111.

The first method of Tsuji forms regions 31 and 32 in a resist layer in the same process step. In subsequent process steps, Tsuji forms regions 33, 34, and 35 within region 31. Therefore, regions 33, 34, and 35 are not distinct from region 31.

The second method of Tsuji forms regions 131 and 132 in resist layer 115, but does not form second features in the resist layer 115 distinct from the first regions in subsequent processing steps.

Therefore, Tsuji fails to disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the imaging layer to form a second feature distinct from the first feature.

Furthermore, Tsuji cannot 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 Tsuji does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the same imaging layer to form a second feature distinct from the first feature. 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 Tsuji.

Consequently, the rejection of claims 12-28 is unsustainable and should be withdrawn.

The objection to the specification, and the rejection of claims 22-25 under 35 U.S.C. § 112, first paragraph, is respectfully traversed.

Applicant respectfully submits that support for the second stabilization step of claims 20 and 25 may be found, for example, at pages 14-19 of the specification and in figures 6-11 as originally filed. For example, figure 6 shows a first stabilization step 320 and a second stabilization step 340.

Applicant submits that support for the claim limitation that the second pattern is different than the first pattern may be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. Nevertheless, this claim limitation has been removed from claims 12 and 25.

Therefore, the objection to the specification, and the rejection of claims 22-25 under 35 U.S.C. § 112, first paragraph, is unsustainable and should be withdrawn.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 12-25 and 27-30 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

Roland B. Cortes
Reg. No. 39,152

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

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.
08/510,717	08/03/95	CLEEVES J	16820.P048D

EXAMINER: DUDA,K

11M1/1010

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

ART UNIT	PAPER NUMBER
1113	10

DATE MAILED: 10/10/96

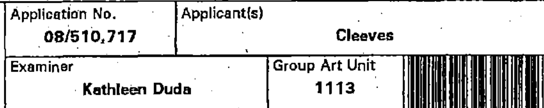
Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (REV. 2/95)

1 - File Copy

Advisory Action	Application No. 08/510,717	Applicant(s) Cleeves
	Examiner Kathleen Duda	Group Art Unit 1113



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

a) [X] 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:

[X] The proposed amendment(s):

- [ ] will be entered upon filing of a Notice of Appeal and an Appeal Brief.
- [X] will not be entered because:
  - [X] 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.
  - [X] they present additional claims without cancelling a corresponding number of finally rejected claims.

NOTE: *The new claims have recitations which require further consideration and possibly 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.

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

Claims allowed: *none*

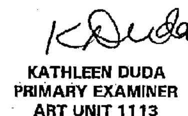
Claims objected to: *none*

Claims rejected: *12-28*

[ ] 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



KATHLEEN DUDA
PRIMARY EXAMINER
ART UNIT 1113

EXTENSION OF TIME ONLY

Attorney's Docket No. 16820.P048D   Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

#11 Ext. of time 2 mos. M. Watts 11/5/96

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

Prior Application: 08/510,717
Examiner: Duda, K.
Art Unit: 1113

RULE 62

RECEIVED
OCT 31 1996
GROUP 1100

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

_______ Continuation application   XX Divisional application

under 37 C.F.R. § 1.62 of pending prior nonprovisional application no. 08/510,717,

filed on August 3, 1995,

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 EM531594550US

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

380 MM 10/28/96 08510747
1 116 390.00 CK

Application

_____ 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

For:	(Col. 1) No. Filed		(Col. 2) No. Extra	SMALL ENTITY Rate	SMALL ENTITY Fee	OTHER THAN A SMALL ENTITY Rate	OTHER THAN A SMALL ENTITY Fee
Basic Fee:					$ 385		$ 770
Total Claims:	18	- 20	* 0	x 11	$	x 22	$ 0
Indep. Claims:	2	- 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:

_X_ (a) -- This is a _XX_ continuation/_____ divisional of application no. 08/510,717, filed 08/03/95, now abandoned. --

_X_ (b) --, which is a _____ continuation/_XX_ divisional of application no. 08/510,717, filed 08/03/95, now abandoned. ______________. -- (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. (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. 08/510,717 filed 08/03/95.

_______ (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: 10/22/96

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)

PATENT APPLICATION SERIAL NO. ____________

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

350 SC 11/14/96 08740014
1 101 770.00 CK 16820.P048D

PTO-1556
(5/87)

BAR CODE LABEL

U.S. PATENT APPLICATION

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT
08/740,014	10/23/96	430	1113

APPLICANT

JAMES M. CLEEVES, REDWOOD CITY, CA.

CONTINUING DATA*******************
VERIFIED THIS APPLN IS A DIV OF 08/510,717 08/03/95
WHICH IS A DIV OF 08/361,595 12/22/94

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

FOREIGN FILING LICENSE GRANTED 11/17/96

STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS	FILING FEE RECEIVED	ATTORNEY DOCKET NO.
CA	10	18	2	$770.00	16820.P048D

ADDRESS

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

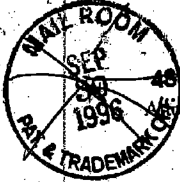
TITLE

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



Attorney Docket No.: 16820.P048D

Patent

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

BOX AF
RECEIVED
OCT 5 1996
GROUP 1100

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/510,717

Filed: August 3, 1995

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 September 24, 1996
Date of Deposit
Dulcie G. Stinson
Name of Person Mailing Correspondence
Dulcie G. Stinson 9/24/96
Signature Date

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 May 28, 1996, which was made final, Applicant submits this Amendment After Final Action for consideration.

IN THE CLAIMS

Please cancel claim 26.

Please amend claims 12, 20, 23, 24, 25, 27, and 28 as follows.

1 12. (Twice Amended) A lithography method for semiconductor fabrication
2 using a semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 (b) exposing a portion of the imaging layer to radiation in accordance
5 with a first pattern to form a first feature;
6 (c) stabilizing the exposed portion of the imaging layer; and

7 (d) patterning the imaging layer in accordance with a second pattern to form a second feature distinct from the first feature, the first and second features

9 [to form] forming a patterned layer, [said second pattern being different than said

10 first pattern], wherein the [patterned layer has adjacent features which] the first

11 and second features are formed relatively closer to one another than is possible

12 through a single exposure to radiation.

1 9 20. (Once Amended) The method of claim 1 12, wherein the patterning step

2 (d) includes the steps of:

3 (i) exposing another portion of the imaging layer to radiation in

4 accordance with the second pattern,

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

6 [(iii) exposing the imaging layer to radiation, and]

7 (i[v]ii) developing the imaging layer to form the patterned layer.

1 12 23. (Once Amended) The lithography method of Claim 1 12, wherein said

2 [adjacent] first and second features comprise a plurality of disposable posts.

1 13 24. (Once Amended) The lithography method of Claim 1 12, wherein said

2 [adjacent] first and second features have a pitch which is not limited by a single

3 exposure to radiation.

1 25. (Once Amended) A lithography method for semiconductor fabrication

2 using a semiconductor wafer, comprising the steps of:

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

4 (b) exposing a first portion of the imaging layer to radiation in

5 accordance with a first pattern to form a first feature;

6 (c) stabilizing the exposed first portion of the imaging layer;

7 (d) exposing a second portion of the imaging layer in accordance with a

8 second pattern to form a second feature distinct from the first feature[, wherein

9 said second pattern is different than said first pattern];

10 (e) stabilizing the exposed second portion of the imaging layer; and

11 (f) developing the imaging layer to form a patterned layer, wherein the

12 first and second features are formed relatively closer to one another than is

13 possible through a single exposure to radiation.

1 27. (Once Amended) The lithography method of Claim 25, wherein the

2 [patterned layer comprises a plurality of] the first and second features comprise

3 disposable posts[, each disposable post being formed relatively closer to other

4 disposable posts than is possible through a single exposure to radiation].

1 28. (Once Amended) The lithography method of Claim 25, wherein the

2 [patterned layer has adjacent features, the adjacent] the first and second features

3 [having] have a pitch which is not limited by a single exposure to radiation.

Please add new claims 29 and 30.

1 ~~29.~~ 14 (New) The lithography method of Claim ~~12~~ 1, wherein the first and

2 second features do not overlap.

1 ~~30.~~ 18 (New) The lithography method of Claim ~~25~~ 15, where the first and

2 second features do not overlap.

31

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.

Claim 26 has been canceled. Claims 12, 20, 23-25, 27, and 28 have been amended to better define the claimed invention. Support for the amendments to claims 12, 20, 23-25, 27, and 28 may be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. No new matter has been added.

New claims 29 and 30 have been added. Support for new claims 29 and 30 may also be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. No new matter has been added.

The rejection of claims 12-22 under 35 U.S.C. § 102 (a) as being anticipated by Haraguchi et al. ("Haraguchi") is respectfully traversed. Furthermore, the rejection of claims 23-28 under 35 U.S.C. § 103 as being unpatentable over Haraguchi is respectfully traversed.

Haraguchi discloses a method of forming contact holes in a semiconductor substrate and simultaneously in an electrode formed on the substrate. (column 1, lines 6-8). As illustrated in figure 3B of Haraguchi, photoresist layer 26 is exposed to ultraviolet light through mask 27 forming exposed portions 29 and unexposed portions 30_{11}, 30_{12}, and 30_2 in layer 26. (see also column 4, lines 27-31). Figures 3C-3K illustrate that portions 30_{11}, 30_{12}, and 30_2 are further processed in order to create contact holes 39_1, 39_2, and 40, respectively.

Haraguchi does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the imaging layer to form a

second feature distinct from the first feature. As described above, Haraguchi forms portions 30_{11}, 30_{12}, and 30_2 in response to a first exposure as illustrated in figure 3B, but does not form second features in layer 26 distinct from the first portions in subsequent processing steps. Therefore, Haraguchi does not anticipate the presently claimed invention.

Furthermore, Haraguchi cannot 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 Haraguchi does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the same imaging layer to form a second feature distinct from the first feature. 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 Haraguchi.

Consequently, the rejections of claims 12-22 and 23-28 are unsustainable and should be withdrawn.

The rejection of claims 12-28 under 35 U.S.C. § 103 as being unpatentable over Tsuji et al. ("Tsuji") is respectfully traversed.

Tsuji discloses two methods of forming a stepwise taper in a contact hole. (column 1, lines 7-13). Figures 4A-4G illustrate a first method of forming a stepwise taper. As illustrated in figures 4A of Tsuji, resist 13 is exposed to ultraviolet light through mask 16 forming unexposed regions 31 and 32. Regions 31 and 32 are then subjected to an image reversal process. (see also column 3, lines 61-63; and column 4, lines 12-40). Figure 4B then shows that a subsection 33 of region 31 is exposed to ultraviolet light. Figures 4C through 4G illustrate that

further processing steps expose and develop more of the area of region 31 in steps to create a stepwise taper including subsections 33, 34, and 35.

Figures 7A-7F illustrate a second method forming a stepwise taper in a contact hole. Figure 7B illustrates that resist 115 is exposed to ultraviolet light through masks 113 and 114 forming unexposed regions 131 and 132. Regions 131 and 132 are then subjected to an image reversal process. (see also, column 6, lines 7-32). Region 131 is then exposed and developed in figure 7C. Figures 7D-7E illustrate that the areas of insulating layer 111 immediately beneath regions 131 and 132 are subjected first to an isotropic etch and a dry etch to create a taper in insulating layer 111.

The first method of Tsuji forms regions 31 and 32 in a resist layer in the same process step. In subsequent process steps, Tsuji forms regions 33, 34, and 35 within region 31. Therefore, regions 33, 34, and 35 are not distinct from region 31.

The second method of Tsuji forms regions 131 and 132 in resist layer 115, but does not form second features in the resist layer 115 distinct from the first regions in subsequent processing steps.

Therefore, Tsuji fails to disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the imaging layer to form a second feature distinct from the first feature.

Furthermore, Tsuji cannot 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 Tsuji does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the same imaging layer to form a second feature distinct from the first feature. 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 Tsuji.

Consequently, the rejection of claims 12-28 is unsustainable and should be withdrawn.

The objection to the specification, and the rejection of claims 22-25 under 35 U.S.C. § 112, first paragraph, is respectfully traversed.

Applicant respectfully submits that support for the second stabilization step of claims 20 and 25 may be found, for example, at pages 14-19 of the specification and in figures 6-11 as originally filed. For example, figure 6 shows a first stabilization step 320 and a second stabilization step 340.

Applicant submits that support for the claim limitation that the second pattern is different than the first pattern may be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. Nevertheless, this claim limitation has been removed from claims 12 and 25.

Therefore, the objection to the specification, and the rejection of claims 22-25 under 35 U.S.C. § 112, first paragraph, is unsustainable and should be withdrawn.

CONCLUSION

In view of the foregoing, it is respectfully submitted that Claims 12-25 and 27-30 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.

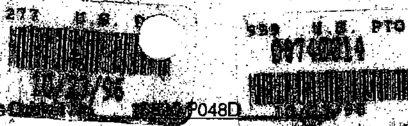
Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: September 24, 1996

Roland B. Cortes
Reg. No. 39,152

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



Attorney's [illegible] P048D   Patent

#13/D

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

Prior Application: 08/510,717
Examiner: Duda, K.
Art Unit: 1113

RULE 62

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

_______ Continuation application   XX Divisional application

under 37 C.F.R. § 1.62 of pending prior nonprovisional application no. 08/510,717,

filed on August 3, 1995,

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. <u>No such copy of the prior application is included herewith</u>. 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 EM531594550US

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 Bernetzke
(Typed or printed name of person mailing paper or fee)

[signature] 10/22/96
(Signature of person mailing paper or fee)

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

D

______ 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:	18	- 20	* 0	x 11	$	x 22	$ 0
Indep. Claims:	2	- 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:

__X__ (a) -- This is a XX continuation/______ divisional of application no. 08/510,717, filed 08/03/95, now abandoned, which

__X__ (b) --, which is a ______ continuation/ XX divisional of application no. 08/510,717, filed 08/03/95 ~~now abandoned~~

~~____________________ -- (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. 08/510,717 filed 08/03/95.

_____ (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

IPR2014-01030 / TSMC-1018
Page 137 of 178

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 [signature]
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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/740,014	10/23/96	CLEEVES J	16820.P048D

11M1/0107
BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
SEVENTH FLOOR
12400 WILSHIRE BOULEVARD
LOS ANGELES CA 90025

EXAMINER
DUDA,K

ART UNIT	PAPER NUMBER
1113	14

DATE MAILED: 01/07/97

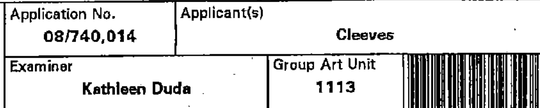
Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-90C (REV. 2/95)

1 - File Copy

Office Action Summary	Application No. 08/740,014	Applicant(s) Cleeves
	Examiner Kathleen Duda	Group Art Unit 1113



☐ Responsive to communication(s) filed on ________.

☐ 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) *12-25 and 27-30* is/are pending in the application.

Of the above, claim(s) ________ is/are withdrawn from consideration.

☐ Claim(s) ________ is/are allowed.

☒ Claim(s) *12-25 and 27-30* 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). ________

☐ 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 12-25 and 27-30 are pending in this application.

Claim Rejections - 35 USC § 103

2. The Examiner agrees with Applicant's arguments in regards to Haraguchi and those art rejections have been removed from the rejection.

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

> (a) 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.

4. Claims 12-25 and 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji (US Patent 4,985,374).

Tsuji teaches a process of patterning whereby a positive resist is applied to a substrate. The resist layer is exposed to form two regions. The resist is then heated in an ammonia environment before exposing to a pattern to form another exposed region. Further processing of the layer then occurs.

Therefore, it would have been obvious to one of skill in the art to have used an ammonia/heat step between two exposure steps

because Tsuji teaches such a process in the manufacture of semiconductor device.

Applicant argues that Tsuji in Figure 4A shows unexposed regions 31 and 32 and then a subsection of 31 (33) is then exposed. Figure 4A shows peripheral areas being exposed followed by a portion of the unexposed area then being exposed. This area appears to be distinct from the area which is first exposed. The claim defines the first feature as being formed by the first exposure and the second feature being formed by the second exposure.

Conclusion

5. 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.

KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

kad
1-6-97

Attorney's Docket No.: 016820.P048DC

Patent

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

Application No.: 08/740,014

Filed: October 23, 1996

For: METHOD FOR REDUCED PITCH LITHOGRAPHY (title)

ASSISTANT COMMISSIONER FOR PATENTS
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.

__X__ 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	*18	Minus	**20	0	x11	$	x22	$ 0
Indep. Claims	*2	Minus	***3	0	x40	$	x80	$0
First Presentation of Multiple Dependent Claim(s)					+130	$	+260	$
					Total Add. Fee	$	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.

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 March 11, 1997
Date of Deposit

Anne Gernetzke
Name of Person Mailing Correspondence

[signature] 3/11/97
Signature Date

_______ 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) for $..

_______ A check for $_____________ is attached for processing fees under 37 C.F.R. § 1.17.

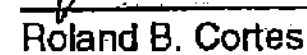
_______ Please charge my Deposit Account No. 02-2666 the amount of $_________________.
A duplicate copy of this sheet is enclosed.

_X___ The Commissioner of Patents and Trademarks 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 LLP



Date: 7/11, 1997

Roland B. Cortes

Reg. No. 39,152

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

Attorney's Docket No.: 016820.P048DC

Patent

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

Application No.: 08/740,014

Filed: October 23, 1996

For: METHOD FOR REDUCED PITCH LITHOGRAPHY (title)

ASSISTANT COMMISSIONER FOR PATENTS
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.
__X__ 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	*18	Minus	**20	0	x11	$	x22	$ 0
Indep. Claims	*2	Minus	***3	0	x40	$	x80	$0
☐ First Presentation of Multiple Dependent Claim(s)					+130	$	+260	$
					Total Add. Fee	$	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.

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on March 11, 1997
Date of Deposit

Anne Gernetzke
Name of Person Mailing Correspondence

Anne Gernetzke (signature) — 3/11/97
Signature — Date

_______ 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) for $..

_______ 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.

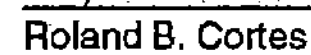
__X__ The Commissioner of Patents and Trademarks is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 02-2666 **(a duplicate copy of this sheet is enclosed):**

__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 LLP

Date: 3/11, 1997



Roland B. Cortes

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

Reg. No. 39,152

Attorney Docket No.: 16820.P048DC Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James M. Cleeves

Serial No.: 08/740,014

Filed: October 23, 1996

For: **METHOD FOR REDUCED PITCH LITHOGRAPHY**

Examiner: Duda, K.

Art Group: 1113

Assistant Commissioner of Patents
Washington, DC 20231

AMENDMENT

Sir:

In response to an outstanding Office Action, mailed January 7, 1997 please amend the above-identified application and consider the following remarks.

IN THE CLAIMS

Please amend claims 12, 25, 27 and 28.

1 ~~12~~. (Three Times Amended) A lithography method for semiconductor
2 fabrication using a semiconductor wafer, comprising the steps of:
3 (a) forming an imaging layer over the semiconductor wafer;
4 with a first pattern to form a first feature;

FIRST CLASS CERTIFICATE OF MAILING

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Date of Deposit

Anne Gemetzke

Name of Person Mailing Correspondence

[signature] 3/11/97

Signature Date

5 (b) exposing a portion of the imaging layer to radiation in accordance

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

7 (d) patterning the imaging layer in accordance with a second pattern to

8 form a plurality of second features distinct from the first feature, the first and

9 second features forming a patterned layer, wherein the first feature is interposed

10 between two of the plurality of second features such that the first and second

11 features are formed relatively closer to one another than is possible through a

12 single exposure to radiation.

---

1 15 ~~25~~. (Twice Amended) A lithography method for semiconductor fabrication

2 using a semiconductor wafer, comprising the steps of:

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

4 (b) exposing a first portion of the imaging layer to radiation in

5 accordance with a first pattern to form a first feature;

6 (c) stabilizing the exposed first portion of the imaging layer;

7 (d) exposing a second portion of the imaging layer in accordance with a

8 second pattern to form a plurality of second features distinct from the first

9 feature, wherein the first feature is interposed between two of the plurality of

10 second features;

11 (e) stabilizing the exposed second portion of the imaging layer; and

12 (f) developing the imaging layer to form a patterned layer, wherein the

13 first and second features are formed relatively closer to one another than is

14 possible through a single exposure to radiation.

---

1 16 ~~27~~. (Twice Amended) The lithography method of Claim 15 ~~25~~, wherein the [the]

2 first and second features comprise disposable posts.

1 17 28. (Twice Amended) The lithography method of Claim 15 27, wherein the [the]
2 first and second features have a pitch which is not limited by a single exposure to
3 radiation.

REMARKS

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

Claims 12, 20, 23-25, 27, and 28 have been amended to better define the claimed invention. Support for the amendments to claims 12, 20, 23-25, 27, and 28 may be found, for example, at pages 14-25 of the specification and figures 6-16 as originally filed. No new matter has been added.

The rejection of claims 12-28 under 35 U.S.C. § 103 as being unpatentable over Tsuji et al. ("Tsuji") is respectfully traversed.

Figures 4A-4G of Tsuji disclose a method of forming a stepwise taper in a contact hole. (column 1, lines 7-13). As illustrated in figure 4A of Tsuji, resist 13 is exposed to ultraviolet light through mask 16 forming unexposed regions 31 and 32 and exposed regions 13 and 17. Regions 31 and 32 are then subjected to an image reversal process. (see also column 3, lines 61-63; and column 4, lines 12-40). Figure 4B shows that a subsection 33 of region 31 is exposed to ultraviolet light. Figures 4C through 4G illustrate that further processing steps expose and develop more of the area of region 31 to create a stepwise taper including subsections 33, 34, and 35.

Thus, Tsuji forms unexposed regions 13 in a resist layer in a first process step, and regions 33, 34, and 35 between regions 13 in subsequent process steps.

Tsuji fails to disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the imaging layer to form a plurality of second features distinct from the first feature, <u>such that the first feature is</u>

interposed between two of the second features. In contrast, Tsuji discloses that (regions 33, 34, and 35) are interposed between first features (regions 13).

Furthermore, Tsuji cannot 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 Tsuji does not disclose exposing a portion of an imaging layer to form a first feature and subsequently patterning the same imaging layer to form a plurality of distinct second features, such that the first feature is interposed between two of the second features. 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 Tsuji.

Consequently, the rejection of claims 12-28 is unsustainable and should be withdrawn.

In view of the foregoing, it is respectfully submitted that Claims 12-25 and 27-30 of the present Application are in condition for allowance and reconsideration and allowance of the claims is respectfully solicited at the Examiner's earliest convenience.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: 3/11, 1997

Roland B. Cortes
Reg. No. 39,152

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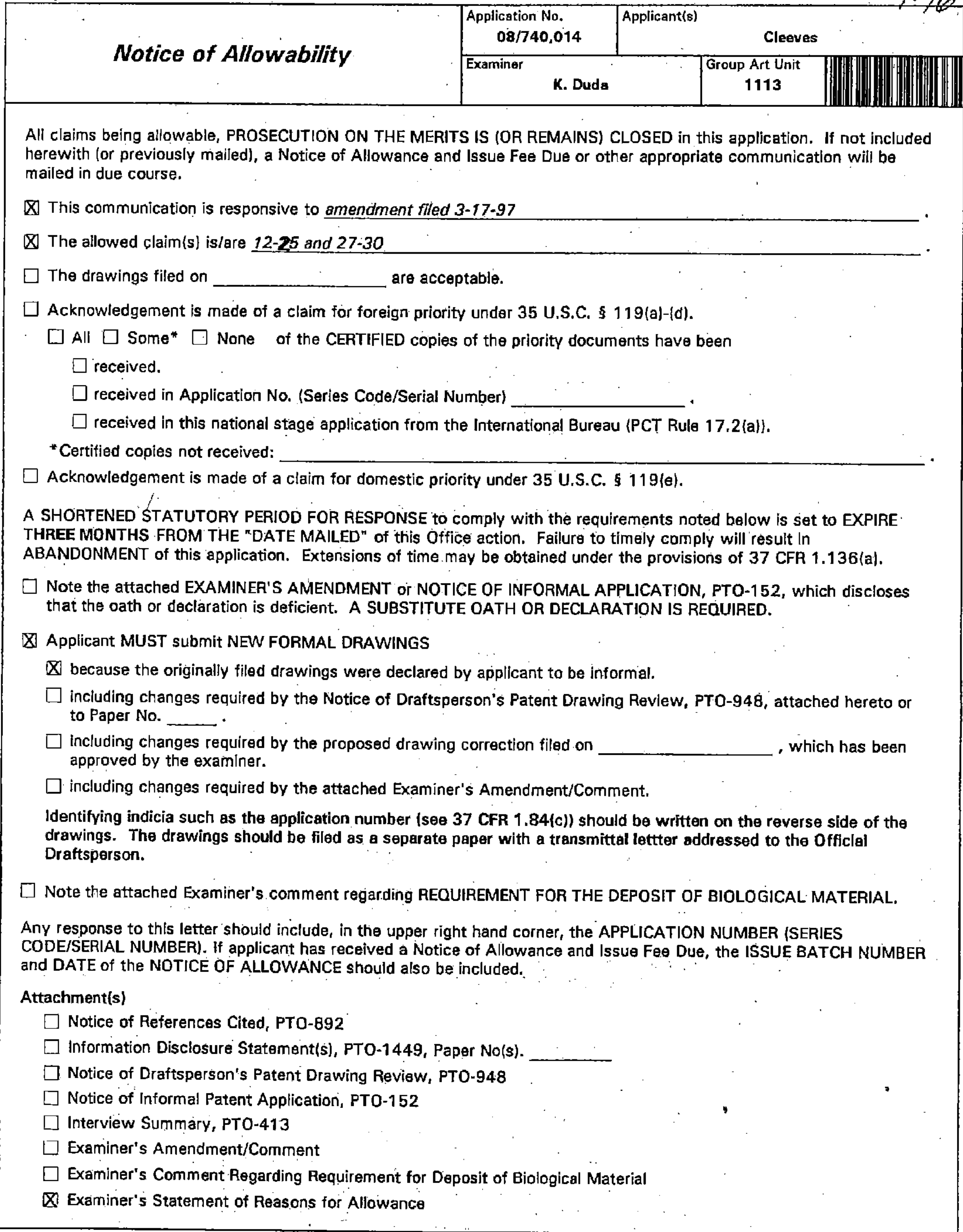
Seventh Floor
Los Angeles, CA 90025
(408) 720-8598



#16

Notice of Allowability	Application No. 08/740,014	Applicant(s) Cleeves
	Examiner K. 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 *amendment filed 3-17-97*.

☒ The allowed claim(s) is/are *12-25 and 27-30*.

☐ 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. ____.

☐ 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

U. S. Patent and Trademark Office
PTO-37 (Rev. 9-95) Notice of Allowability Part of Paper No. 16

REASONS FOR ALLOWANCE

1. The following is an examiner's statement of reasons for allowance:

Claims 12-25 and 27-30 have been found to be allowable over the prior art of record. The claims have been amended to recite that the first feature is interposed between two of the second features formed. Tsuji teaches forming a first feature 13 and then forming second features 33, 34, 35. The second features are interposed between the first features in Tsuji. The invention of the amended claims is not taught nor suggested by Tsuji.

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."

2. 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.

KDuda
KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

kad
5-30-97

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

11M1/0602
BLAKELY SOKOLOFF TAYLOR AND ZAFMAN
SEVENTH FLOOR
12400 WILSHIRE BOULEVARD
LOS ANGELES CA 90025

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT		DATE MAILED
08/740,014	10/23/96	018	DUDA, K	1113	06/02/97

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.P048D	430-312.000	N63	UTILITY	NO	$1290.00	09/02/97

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.***

Attorney's Docket No.: 16820.P048DC | Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: James M. Cleeves	Examiner: Duda, K.
Serial No.: 08/740,014	Art Unit: 1113
Filing Date: October 23, 1996	Batch No.: N63
For: METHOD FOR REDUCED PITCH LITHOGRAPHY	
A Continuation of:	RECEIVED Publishing Division
Application No.: 08/510,717	JUL 21 1997
Filed: August 3, 1995	08

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 June 2, 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: 7/16, 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 July 16, 1997
Date of Deposit

Patricia A. Balero
Name of Person Mailing Correspondence

Signature | 07/16/97 Date

Attorney's Docket No.: 16820.P048DC Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: James M. Cleeves	Examiner: Duda, K.
Serial No.: 08/740,014	Art Unit: 1113
Filing Date: October 23, 1996	Batch No.: N63
For: METHOD FOR REDUCED PITCH LITHOGRAPHY	
A Continuation of:	
Application No.: 08/510,717	
Filed: August 3, 1995	

BOX ISSUE FEE
Assistant Commissioner for Patents
Washington, D.C. 20231

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BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 7/16, 1997

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Date of Deposit

Patricia A. Balero
Name of Person Mailing Correspondence

Signature 07/16/97
Date

APPROVED BY DRAFTSMAN | O.G. FIG 6, 12, 15 + 16 | CLASS 430 | SUBCLASS 312

5686223

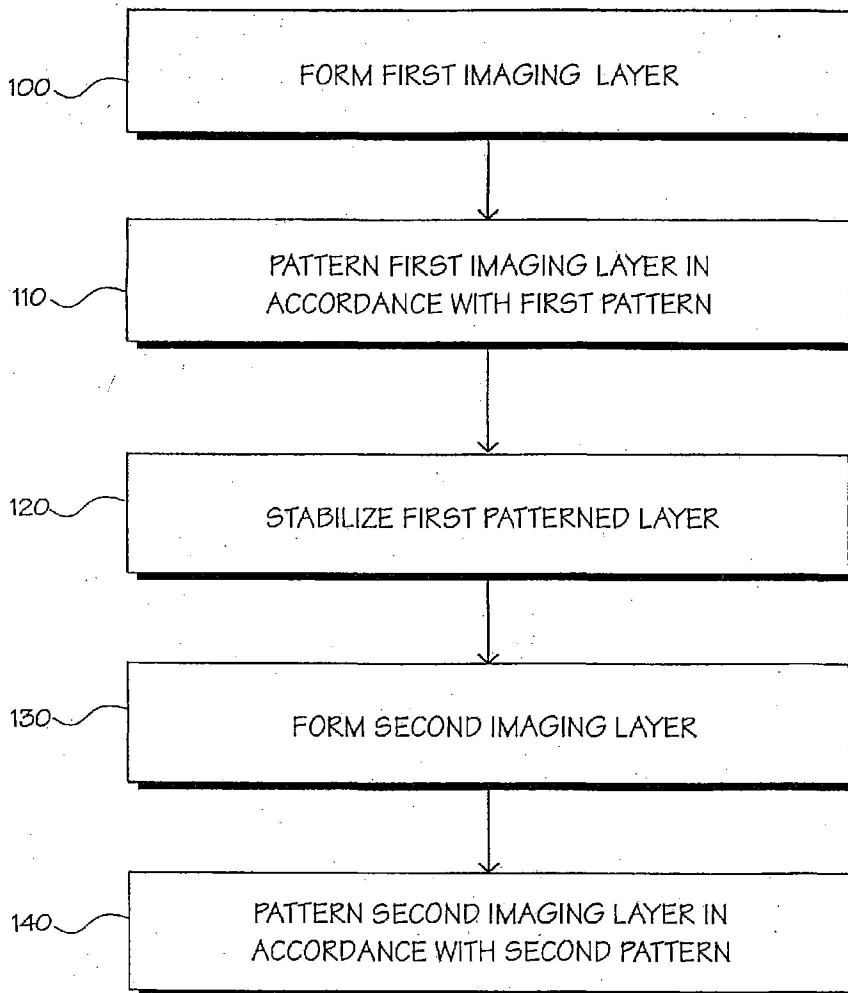

Fig.1

APPROVED BY DRAFTSMAN | O.G. FIG | CLASS | SUBCLASS

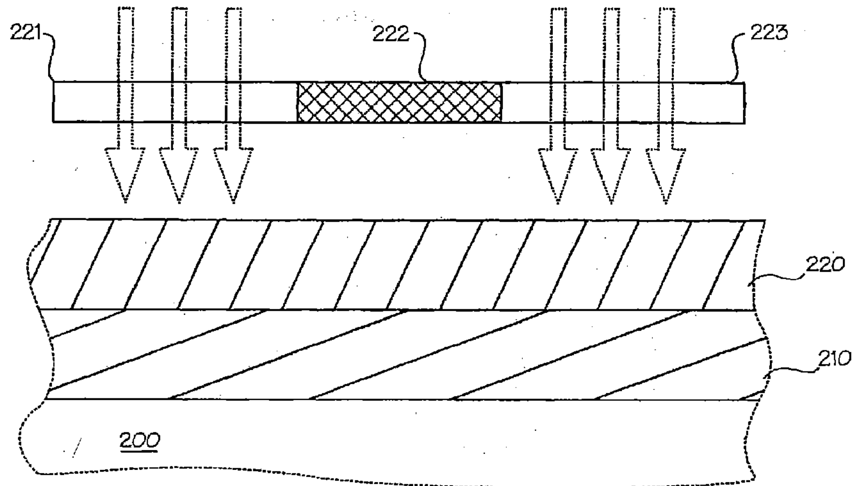

Fig.2

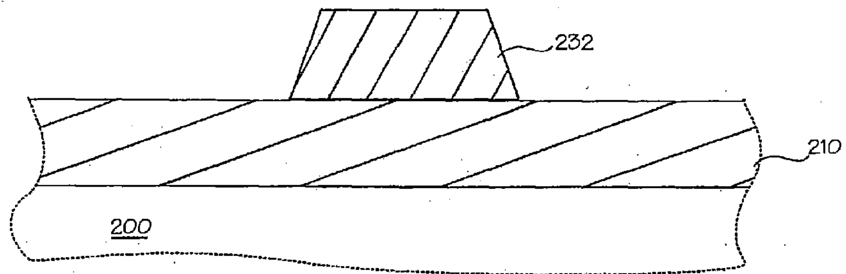

Fig.3

APPROVED BY DRAFTSMAN | O.G. FIG | CLASS | SUBCLASS

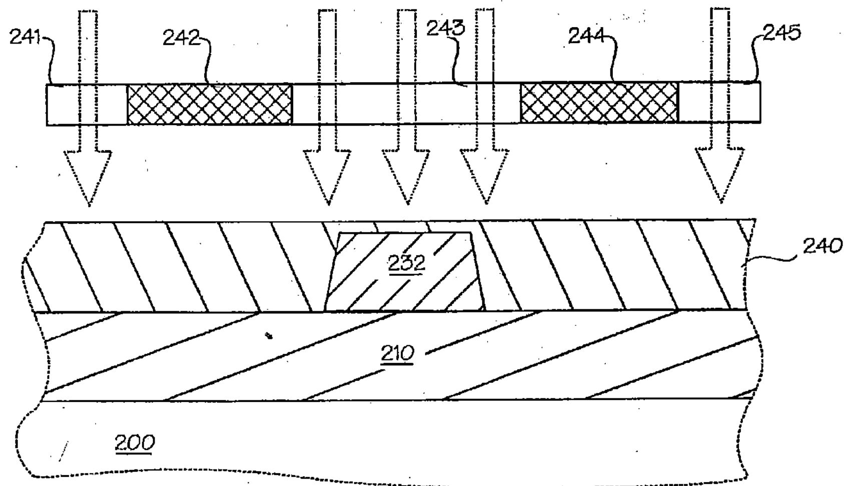

Fig4

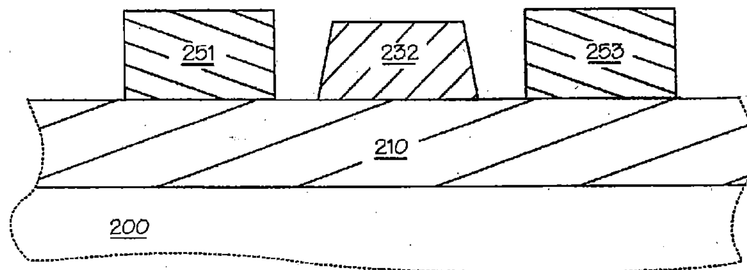

Fig.5

APPROVED BY DRAFTSMAN | O.G. FIG 6, 12, 15, 16 | CLASS 430 | SUBCLASS 312

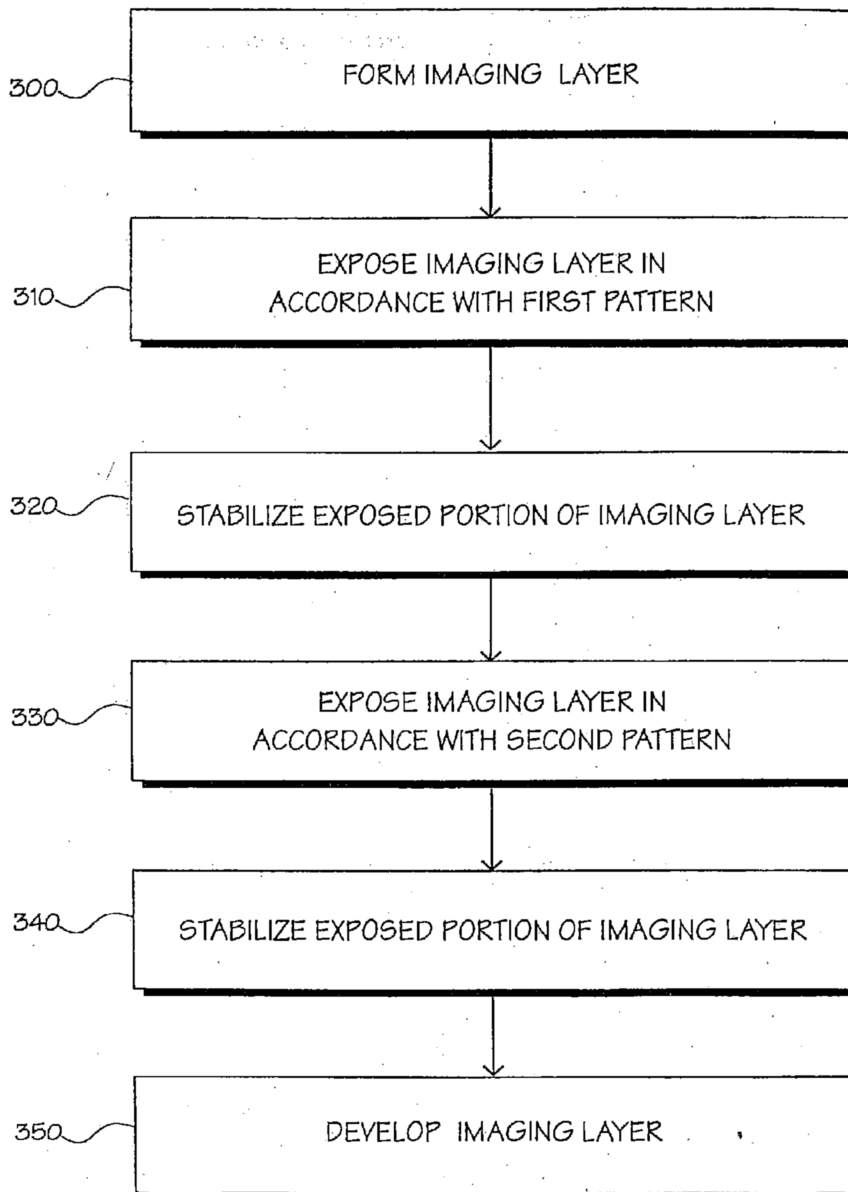

Fig.6

APPROVED BY DRAFTSMAN | O.G. FIG | CLASS | SUBCLASS

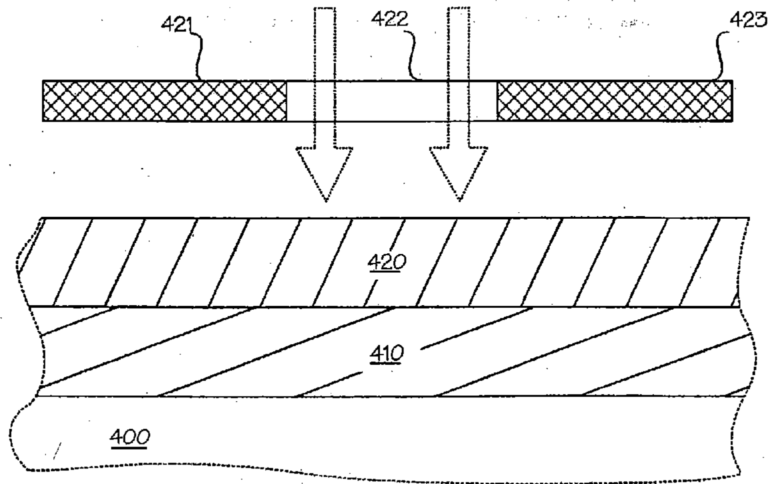

Fig7

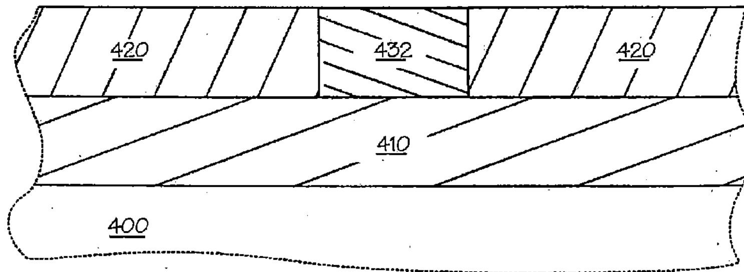

Fig.8

APPROVED BY DRAFTSMAN | O.G. FIG. | CLASS | SUBCLASS

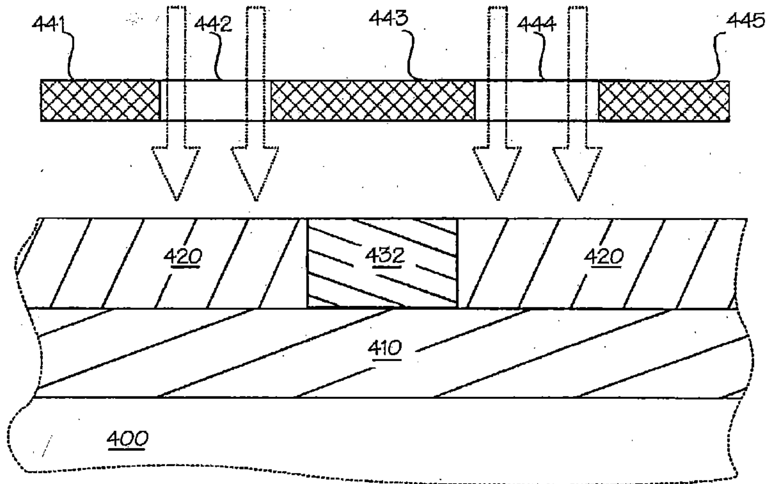

Fig9

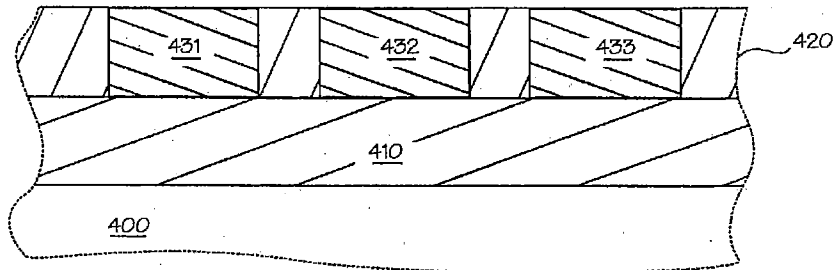

Fig.10

APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

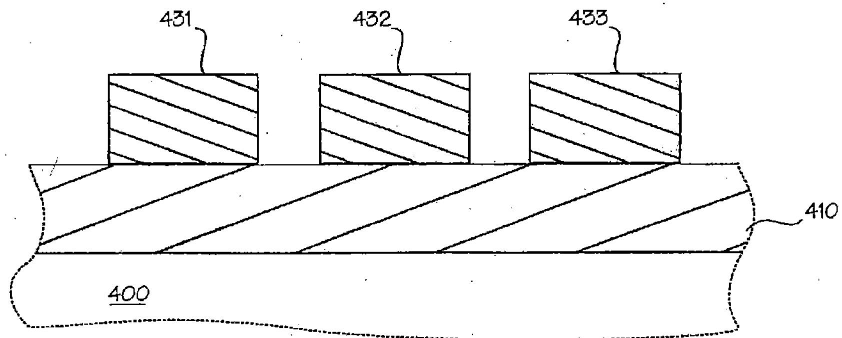

Fig.11

APPROVED BY DRAFTSMAN | O.G. FIG. 6/12 5/16 | CLASS 430 | SUBCLASS 312

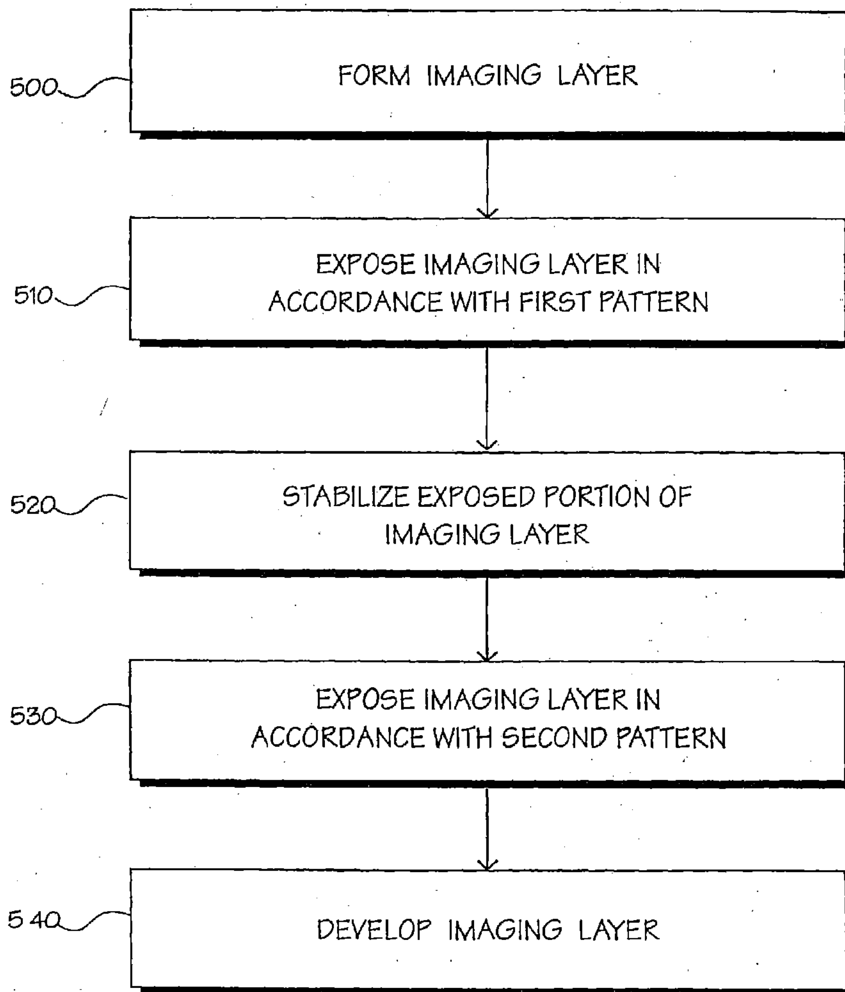

Fig.12

APPROVED BY DRAFTSMAN	O.G. FIG.	
	CLASS	SUBCLASS

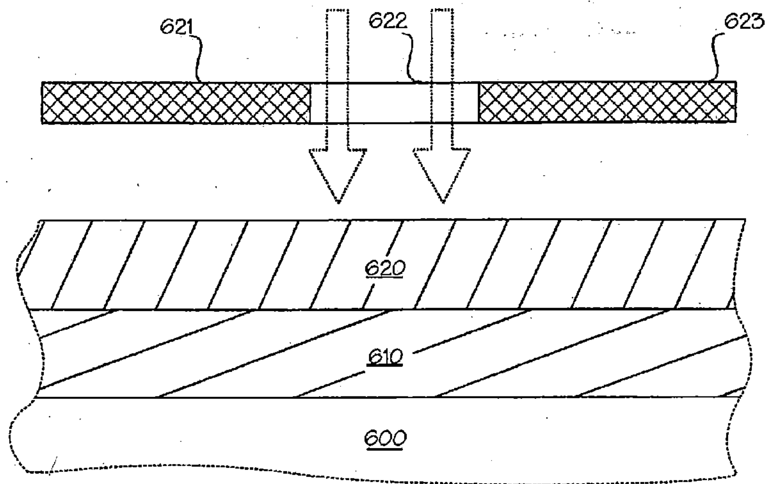

Fig13

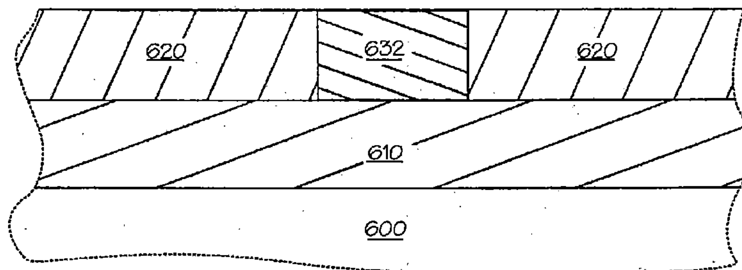

Fig.14

APPROVED BY DRAFTSMAN | O.G. FIG. 6, 12, 15, 16 | CLASS 430 | SUBCLASS 312

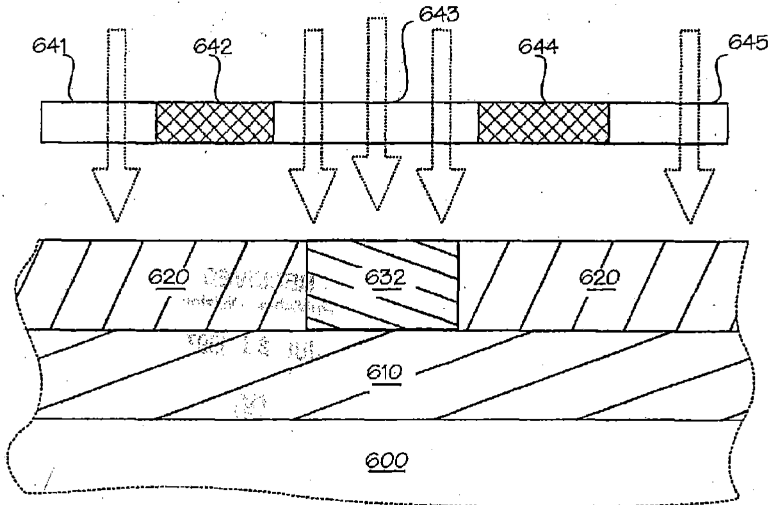

Fig15

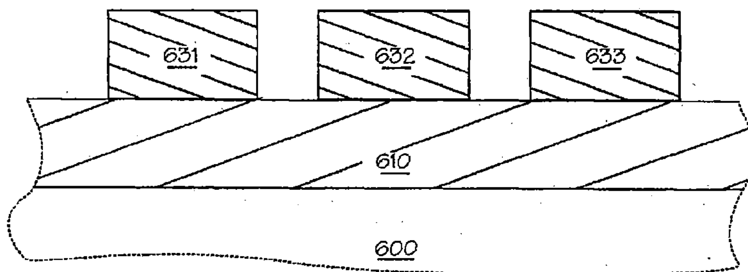

Fig.16

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City, State and Zip Code

☐ Check if additional changes are enclosed.

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT		DATE MAILED
08/740,014	10/23/96	018	DUDA, K	1113	06/02/97

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.P048IC	430-312.000	N63	UTILITY	NO	$1290.00	09/02/97

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1 BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP
2
3

5. ASSIGNMENT DATA TO BE PRINTED ON THE PATENT (print or type)

(1) NAME OF ASSIGNEE: CYPRESS SEMICONDUCTOR CORP.

(2) ADDRESS: (CITY & STATE OR COUNTRY) 3901 North First Street, San Jose, CA

A. ☐ This application is NOT assigned.
☒ Assignment previously submitted to the Patent and Trademark Office.
☐ Assignment is being submitted under separate cover. Assignment should be directed to Box ASSIGNMENTS.

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(Authorized Signature) Tarek N. Fahmi (Date) 7/16/97

Reg. No. P-41,402

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Patricia A. Balero **(Name of person making deposit)**
[signature] **(Signature)**
7/16/97 **(Date)**

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Street Address
City, State and Zip Code

☐ Check if additional changes are enclosed

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First Named Applicant: CLEEVES, JAMES M.

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	ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
1	16820.P048DC	430-312.000	N63	UTILITY	NO	$1290.00	09/02/97

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2.
3.

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(Authorized Signature) Tarek N. Fahmi (Date) 7/16/97
Reg. No. P-41,402

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Washington, D.C. 20231

on: July 16, 1997 **(Date)**
Patricia A. Balero **(Name of person making deposit)**
[signature] **(Signature)**
7/16/97 **(Date)**

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PTO UTILITY GRANT
Paper Number 17

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.

Bruce Lehman
Commissioner of Patents and Trademarks

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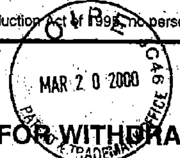

REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT

Patent Number	5,686,223
Issue Date	11/11/1997
First Named Inventor	James M. Cleeves
Group Art Unit	1113
Examiner Name	Duda, K.
Attorney Docket Number	016820.P048DC

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.

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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	[signature]	
Date	3/16/2000	

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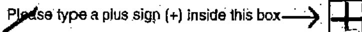
Please type a plus sign (+) inside this box → 

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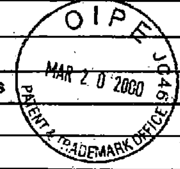
REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT

Patent Number	5,686,223
Issue Date	11/11/1997
First Named Inventor	James M. Cleeves
Group Art Unit	1113
Examiner Name	Duda, K.
Attorney Docket Number	016820.P048DC



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Address	455 North Cityfront Plaza Drive, Suite 3600				
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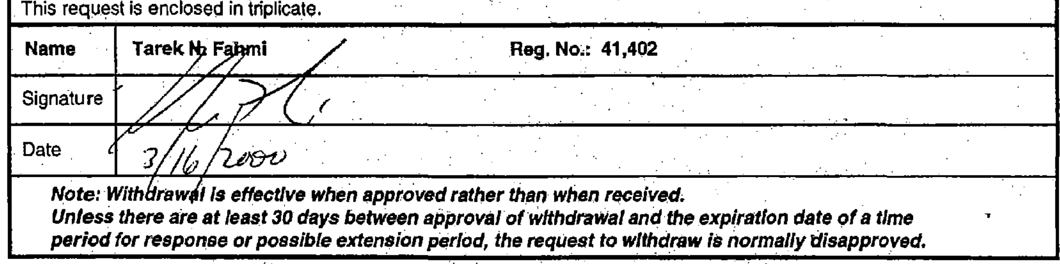

Name	Tarek N. Fahmi	Reg. No.: 41,402
Signature	[signature]	
Date	3/16/2000	

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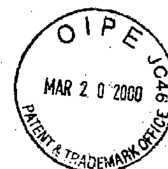

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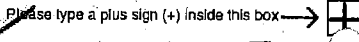

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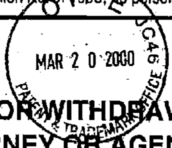

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Issue Date	11/11/1997
First Named Inventor	James M. Cleeves
Group Art Unit	1113
Examiner Name	Duda, K.
Attorney Docket Number	016820.P048DC

To: Assistant Commissioner for Patents
Washington, DC 20231

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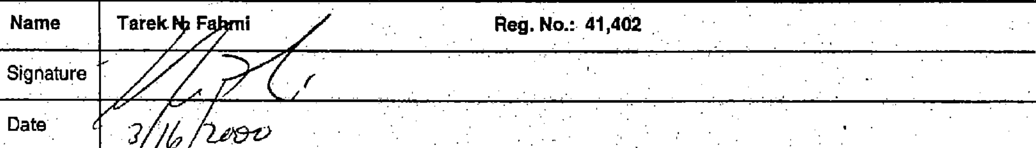
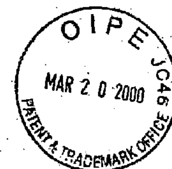


Name	**Tarek N. Fahmi**	**Reg. No.: 41,402**
Signature	[signature]	
Date	3/16/2000	

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.



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.

Application or Docket Number: 08/740014

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 1996

CLAIMS AS FILED - PART I

FOR	NUMBER FILED (Column 1)		NUMBER EXTRA (Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE					385.00	OR		770.00
TOTAL CLAIMS	18	minus 20 =	* 0	x$11=		OR	x$22=	
INDEPENDENT CLAIMS	2	minus 3 =	* 0	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

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL 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

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL 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 C

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL 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	

* 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

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 1994

Application or Docket Number: 08/510717

CLAIMS AS FILED - PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE				365.00	OR		730.00
TOTAL CLAIMS	11 minus 20 =	* —	x$11=		OR	x$22=	
INDEPENDENT CLAIMS	1 minus 3 =	* —	x38=		OR	x76=	
MULTIPLE DEPENDENT CLAIM PRESENT			+120=		OR	+240=	
			TOTAL		OR	TOTAL	730

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

CLAIMS AS AMENDED - PART II

AMENDMENT A

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
Total	*	Minus	**	=	x$11=		OR	x$22=	
Independent	*	Minus	***	=	x38=		OR	x76=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+120=		OR	+240=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
Total	* 11	Minus	** 20	= —	x$11=		OR	x$22=	
Independent	* 2	Minus	*** 3	= —	x38=		OR	x76=	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+120=		OR	+240=	
					TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE	ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	ADDITIONAL FEE
Total	* 18	Minus	** 20	= 0	x$11=		OR	x$22=	
Independent	* 2	Minus	*** 3	= 0	x38= No	fee	OR	x76= fee	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					+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)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

allowed 1-11

Form PTO 1130 (REV 2/94)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

PACE DATA ENTRY CODING SHEET

1ST EXAMINER	[signature]	DATE 9-5-95
2ND EXAMINER		DATE

APPLICATION NUMBER	TYPE APPL	FILING DATE (MONTH / DAY / YEAR)	SPECIAL HANDLING	GROUP ART UNIT	CLASS	SHEETS OF DRAWING
08/510717	1	Ø8 Ø3 95	2	15Ø7	43Ø	Ø1Ø

TOTAL CLAIMS	INDEPENDENT CLAIMS	SMALL ENTITY?	FILING FEE	FOREIGN LICENSE	ATTORNEY DOCKET NUMBER
Ø11	ØØ1	Ø	Ø73Ø	Y	16820.PØ48D

CONTINUITY DATA

CONT CODE	STATUS CODE	PARENT APPLICATION SERIAL NUMBER	PCT APPLICATION SERIAL NUMBER	PARENT PATENT NUMBER	PARENT FILING DATE (MONTH / DAY / YEAR)
Ø1	2	Ø8361595	PCT / /		12 22 94
			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 - 384-021

TITLE OF INVENTION

ATTORNEY REGISTRATION NUMBERS

CORRESPONDENCE NAME AND ADDRESS

APPLICANT/INVENTOR DATA

AUTHORITY CODE

FAMILY NAME

NAME SUFFIX

GIVEN NAME

STATE/CTRY CODE

CITY

AUTHORITY CODE

FAMILY NAME

NAME SUFFIX

GIVEN NAME

STATE/CTRY CODE

CITY

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