5686223 5 ഷ് Class **的**外的问题 PATENT 讀 NOV 1 1 1997 NUMBER NUMBER SERIAL NUMBER -08/740,014 FILING DATE GROUP ART UNIT CLASS SUBCLASS EXAMINER 430 34 312 10 JAMES M. CLEEVES, REDWOOD CITY, 'CA.C. \*\*CONTINUING DATA\*\*\*\*\*\*\*\*\*\* VERIFIED KAR \*\*FOREIGN/PCT APPLICATIONS\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* VERIFIED NONO AD FOREIGN FILING LICENSE GRANTED 11/17/96 Foreign priority claimed 35 USC 119 conditions met yes STATE OR | SHEETS COUNTRY | DRWGS. TOTAL CLAIMS INDEP. CLAIMS FILING FEE ATTORNEY'S AS FILED DOCKET NO. RECEIVED erified and Acknowledged 18 16820.P04 ina) 10 \$778. Examiner BLAKELY SOKOLOFF TAYLOR AND ZAFMAN SEVENTH FLOOR 12400 WILSHIRE BOULEVARD LOS ANGELES CA 90025. METHOD FOR REDUCED PITCH LITHOGRAPHY U.S. DEPT OF COMM / PAT & TM PTO-436L (Rest 25 PARTS OF APPLICATION FILED SEPARATELY NOTICE OF ALLOWANCE MAILED CLAIMS ALLOWED Total Claims Print Claim 197 land 15 18 Assistant Examiner ISSUE FEE DRAWING ( Date Paid Amount Due Sheets Drwg. Figs. Drwg. Pript Fig. 0972 16 6,12,15416 291 10 KATHLEEN DUDA PRIMARY EXAMINER ISSUE. GROUP 1100 Primary Examiner BATCH NUMBER PREPARED FOR ISSUE Label Area 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. 6/92) ISSUE FEE IN FILE -÷ (FACE)

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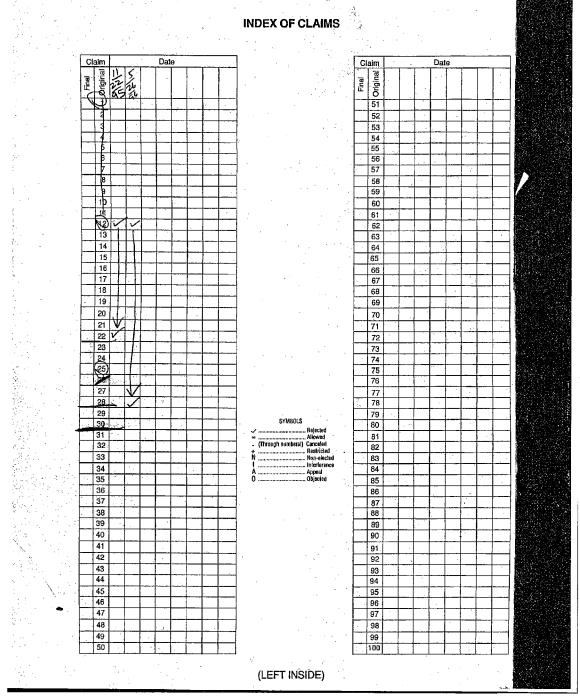


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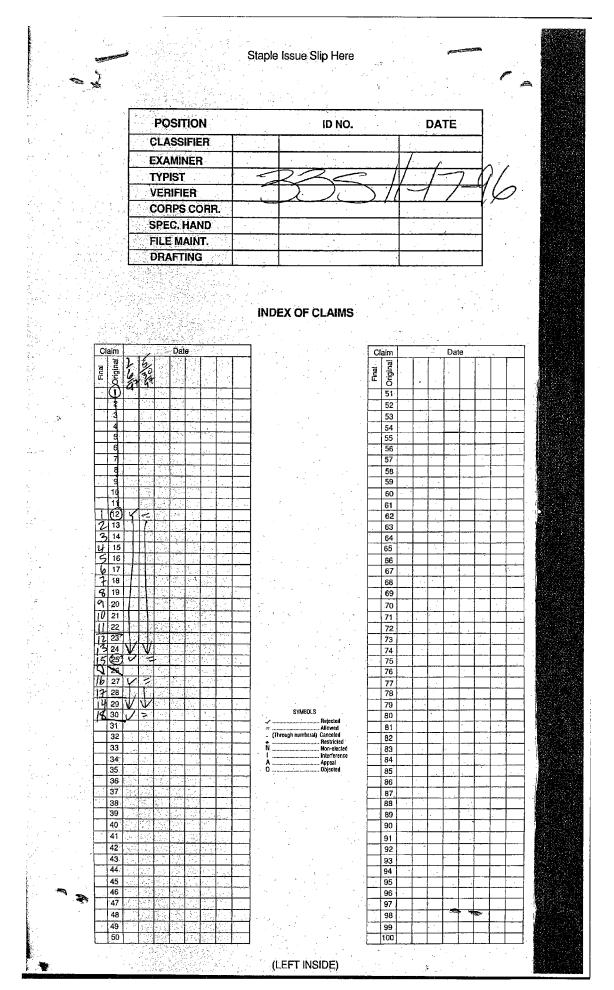
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## INDEX OF CLAIMS



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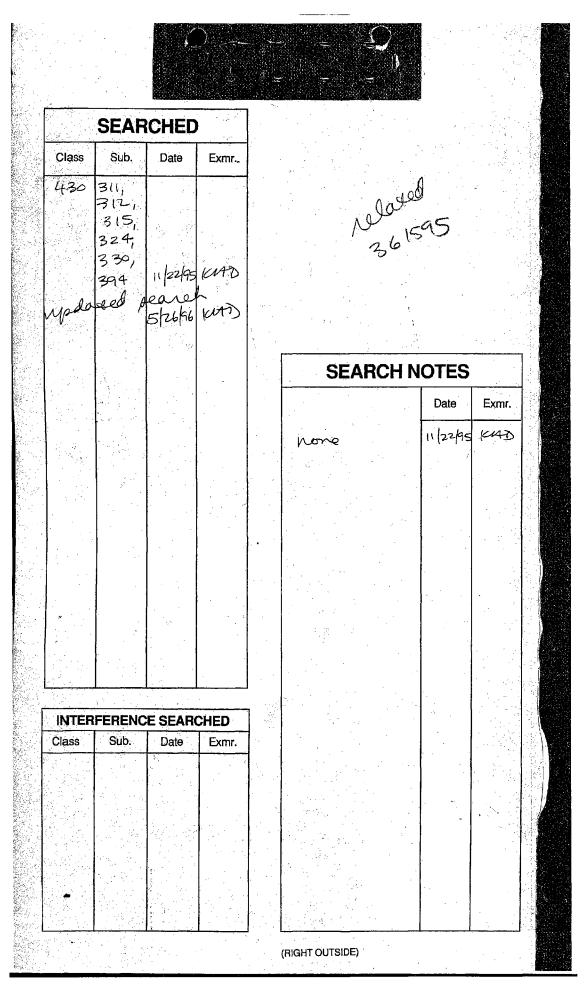
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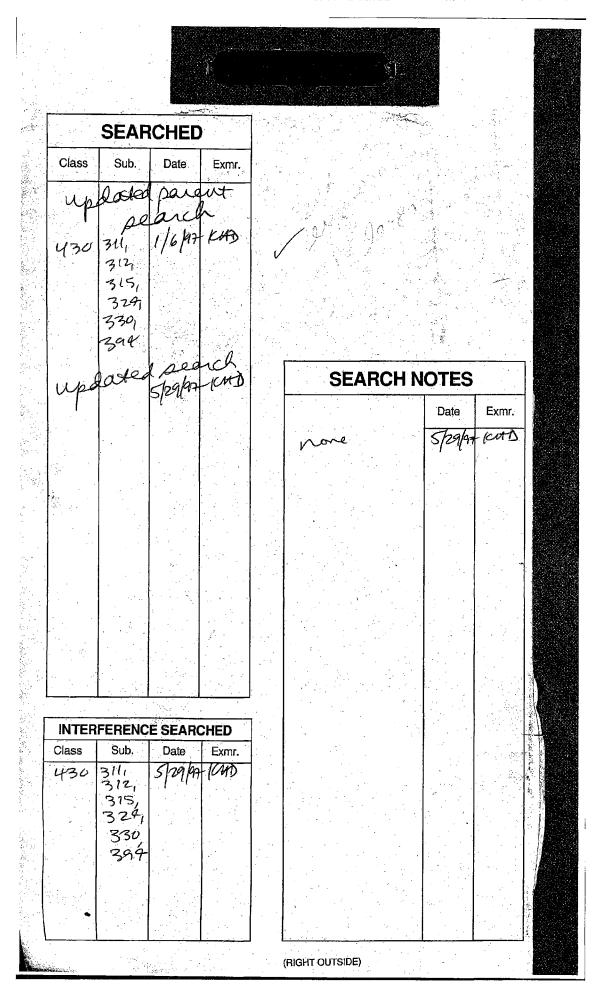
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	BLAKELY, Šú 12400 Wilshi	OKOLÕFF, TAÝLOR & Z/ ire Blvd., Seventh Floor , California 90025	(Reg. No.) certain other listed attorneys AFMAN	or agents of:
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16,

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.

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.

 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,

8/3/9 Date

BLAKELY SOKOLOFF TAYLOR & ZAFMAN By Michael A. Bernadicou

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

Reg. No. 35.934

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Attorney or Agent of Record

\_\_\_\_ Associate Attorney or Agent

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

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



**H** 

## UNITED STATES PATENT APPLICATION

for

## METHOD FOR REDUCED PITCH LITHOGRAPHY

Inventor

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## METHOD FOR REDUCED PITCH LITHOGRAPHY

**BACKGROUND OF THE INVENTION** 

1. Field of the Invention:

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

2. Description of the Related Art:

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

For a typical lithography process, photoresist is deposited over the layer to be patterned and is exposed to ultraviolet radiation through a mask that defines the 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.

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

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#### BRIEF SUMMARY AND OBJECTS OF THE INVENTION

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

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

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

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

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

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

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#### **BRIEF DESCRIPTION OF THE DRAWINGS**

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

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

semiconductor fabrication;

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

Figure 3 illustrates a cross-sectional view of the semiconductor wafer of

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 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;

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

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

Figure 10 illustrates a cross-sectional view of the semiconductor wafer of

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

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

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

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

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

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

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

#### **DETAILED DESCRIPTION**

The following detailed description sets forth an embodiment or embodiments in accordance with the present invention for method for reduced pitch lithography. In the following description, details are set forth such as specific materials,

thicknesses, parameters, etc., in order to provide a thorough understanding of the present invention. It will be evident, however, that the present invention may be practiced without these details. In other instances, well-known process steps, equipment, etc., have not been described in particular detail so as not to obscure the present invention.

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

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

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

As one example, layer 210 may include a layer that is to be patterned in accordance with a subsequent mask layer formed over layer 210. Layer 210 may include a dielectric layer, including silicon dioxide (SiO<sub>2</sub>) for example, that is to be

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

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

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For one embodiment, imaging layer 220 may include a suitable positive photoresist, for example, that has been spun-on to a thickness of approximately 10,000 Angstroms (Å). Other suitable thicknesses of positive photoresist, for example in the range of approximately 1,000 Å to approximately 30,000 Å, may also be used. For other embodiments, imaging layer 220 may include a suitable negative photoresist, a suitable radiation-sensitive polyimide, or other suitable radiationsensitive 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 ebeam radiation, vacuum UV radiation, or ion beam radiation for example.

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

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

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

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

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

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

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

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

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

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

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<sub>4</sub>) skin over first patterned layer 232 by exposing the photoresist to a fluorine ambient. A sufficient technique may also be used to form a silicon dioxide (SiO<sub>2</sub>) 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.

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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

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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 suitable stabilization technique, a suitable radiation treatment, for example, may be used to stabilize the negative photoresist of first patterned layer 232.

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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

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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.

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

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

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

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

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

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

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

For other embodiments where a suitable negative-tone imaging material is used for imaging layer 240, the negative-tone imaging layer 240 may be exposed to any suitable form of radiation through a suitable negative-tone mask having opaque features 241, 243, and 245 and clear features 242 and 244, for example. Negative-tone imaging materials may include a suitable negative photoresist, a suitable positive photoresist that is to be subjected to an image reversal process, or a suitable negative-tone radiation-sensitive polyimide for example. The negative-tone imaging layer 240 may be developed in a suitable developer to form features 251 and

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253 for the second patterned layer as illustrated in Figure 5. That portion of imaging layer 240 exposed to radiation through the second mask is relatively insoluble in the developer and thus remains to form features 251 and 253. That portion of imaging layer 240 that has not been exposed to radiation is soluble in the developer and is thus dissolved from imaging layer 240.

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

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

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

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As a result of the method of Figure 1, a single patterned layer is formed over layer 210 as illustrated in Figure 5. This single patterned layer is formed from the patterning of imaging layer 220 and the subsequent patterning of imaging layer 240. Figure 6 illustrates, in flow diagram form, another lithography method for semiconductor fabrication. For one embodiment, the method of Figure 6 may be used for semiconductor fabrication using a semiconductor wafer, such as the semiconductor wafer illustrated in Figures 7, 8, 9, 10, and 11 for example.

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

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

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

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

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

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

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

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

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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<sub>3</sub>) ambient and heated to a temperature of approximately 95 degrees Celsius, for example, in an approximately 600 torr environment, for example, for approximately 45 minutes, for example. Other suitable temperatures, pressures, and periods of time may also be used. Temperatures may range from approximately 80 degrees Celsius to approximately 110 degrees Celsius, for example. Pressures may range from approximately 500 torr to approximately 760 torr, for example. Time periods may range from approximately 30 minutes to approximately 60 minutes, for example.

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

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

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

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

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

For step 340 of Figure 6, that portion of the imaging layer exposed to radiation for step 330 is stabilized. Any suitable stabilization technique may be used and may depend, for example, on the material used to form imaging layer 420. As illustrated in Figure 10, an exposed portion 431 and 433 of imaging layer 420 has been stabilized. Exposed portion 431 and 433 of imaging layer 420 may be stabilized to withstand subsequent lithographic processing steps. Exposed portion 431 and 433 may be stabilized to withstand chemical transformation as a result of any subsequent exposure to radiation, for example. Exposed portion 431 and 433 may also be stabilized to withstand dissolution by a subsequent developer, for example.

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

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

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

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

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

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layer 410 as illustrated in Figure 11.

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

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

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

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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.

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

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

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

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

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

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

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

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

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

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Where a suitable positive photoresist is used to form imaging layer 620, a suitable image reversal process may be used to stabilize exposed portion 632 of imaging layer 620. For one embodiment, imaging layer 620 may be, after the exposure to radiation through the first mask, subjected to an ammonia (NH<sub>3</sub>) 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. Time periods 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.

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

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

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

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

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

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developer

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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.

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

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

Although the methods of Figures 1, 6, and 12 are illustrated as using masks for the selective exposure of imaging layers to radiation, other suitable lithographic techniques may also be used for the methods of Figures 1, 6, and 12 to expose

imaging layers to radiation in accordance with suitable patterns. As one example, a suitable direct-write exposure technique may be used to expose an imaging layer to radiation in accordance with a suitable pattern.

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

-23-

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

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

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

As another example, the lithography methods of Figures 1, 6, and 12 may be used to form disposable posts as discussed in U.S. Application Serial No. 08/179,615, filed January 10, 1994, entitled DISPOSABLE POST PROCESSING FOR

SEMICONDUCTOR DEVICE FABRICATION, by James M. Cleeves, and assigned to the same assignee as the present application. As disposable posts are removed to form openings for a subsequent layer, such as a contact, via, or interconnect layer for example, such openings may be formed relatively closer to one another.

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

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

What is claimed is:

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

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

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

(c) stabilizing the first patterned layer;

7 forming a second imaging layer over the first patterned layer such that (d) 8

the first patterned layer is surjounded by the second imaging layer; and

.9 patterning the second imaging layer in accordance with a second (e) 10 pattern to form a second patterned layer.

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

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

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

2 exposing a portion of the first imaging layer to radiation in accordance (i)

З with the first pattern, and

1 2

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4 developing the first imaging layer such that the exposed portion (ii)

5 dissolves to form the first patterned layer.

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

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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.

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

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

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.

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

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

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

(ii) heating the first patterned layer.

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

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

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

(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.

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

1  $\mathcal{I}$ . The method of claim  $\mathcal{I}$ , wherein the patterning step (d) includes the steps of:

2 (i) exposing the imaging layer to radiation in accordance with the second3 pattern, and

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

1  $\frac{1}{28}$ . The method of claim  $\frac{12}{12}$ , 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 4.37. The method of claim 12, wherein the stabilizing step (c) includes the step of 2 subjecting the imaging layer to an image reversal process.

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The method of claim W, wherein the subjecting step includes the steps of: subjecting the imaging layer to an ammonia ambient, and (i) heating the imaging layer. (ií)

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0 19. The method of claim 16, 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.

The method of claim 12, wherein the patterning step (d) includes the steps of: 20. exposing another portion of the imaging layer to radiation in ſî accordance with the second pattern,

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

(iii) exposing the imaging layer to radiation, and

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

The method of claim 20, wherein the stabilizing step (d)(ii) includes the step \_21. 2 of subjecting the imaging layer to an image reversal process.

The method of claim 27, wherein the subjecting step includes the steps of: 1 2 (i) subjecting the imaging layer to an ammonia ambient, and

-30-

(ii) heating the imaging layer.

## ABSTRACT OF THE DISCLOSURE

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

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#### 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

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s attached hereto.			
was filed on	December 22, 1994	as	
Application Serial No.	08/361.595		
and was amended on		2	
	(if continuing)		

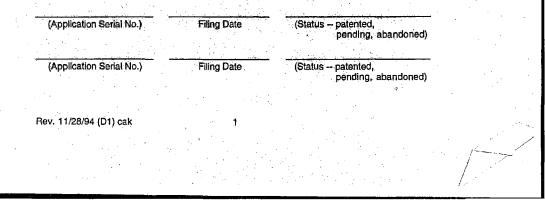
I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention 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 filling date before that of the application on which priority is claimed:

<u>Prior</u>	Foreign Application	<u>(s)</u>		Priori <u>Claim</u>	
•	(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:

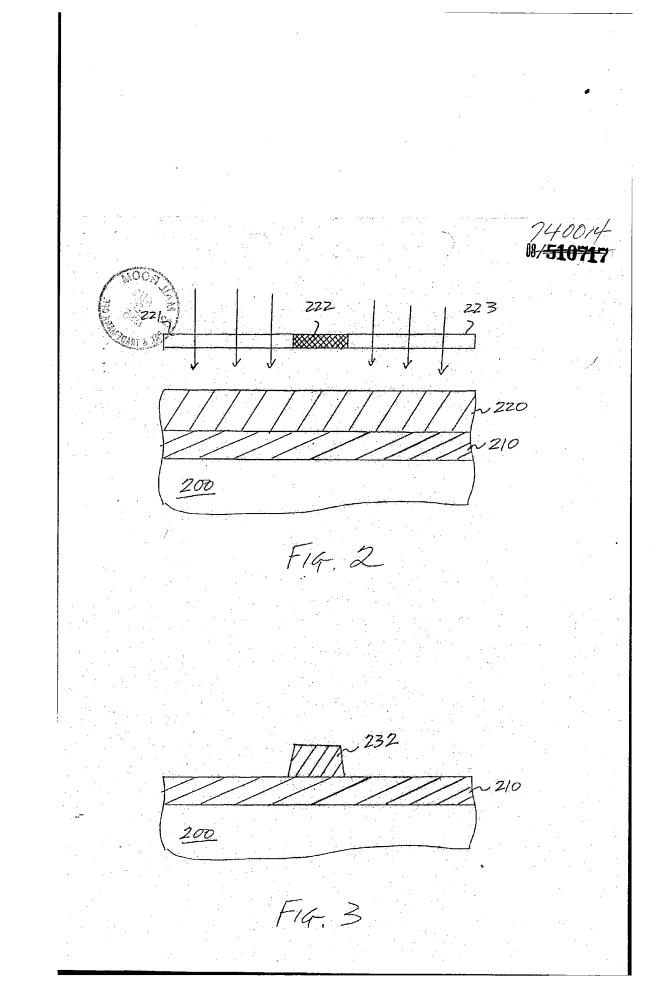


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37,813 Matthew C. 1	. 25,831; Timothy R. Cro Fagan, Reg. No. 37,542;	Scot A. Griffin, Reg. N	o. 38,167; Stephen D.	
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	I Norman Zafman, Reg. N 28: Thomas X, Li, Reg. N		s; and William Donald . Sloane, Reg. No. 34,728;	•
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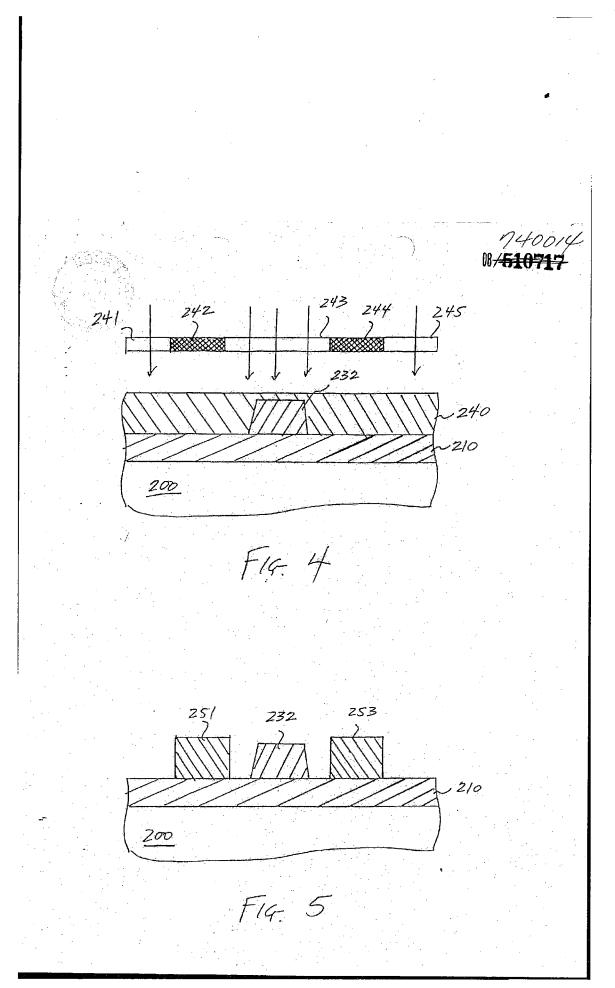
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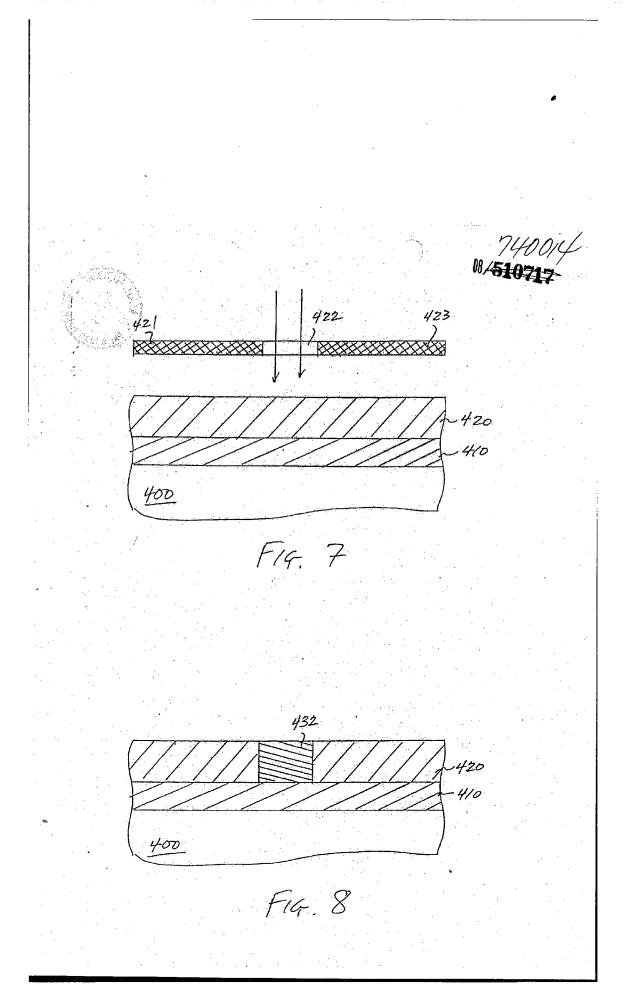


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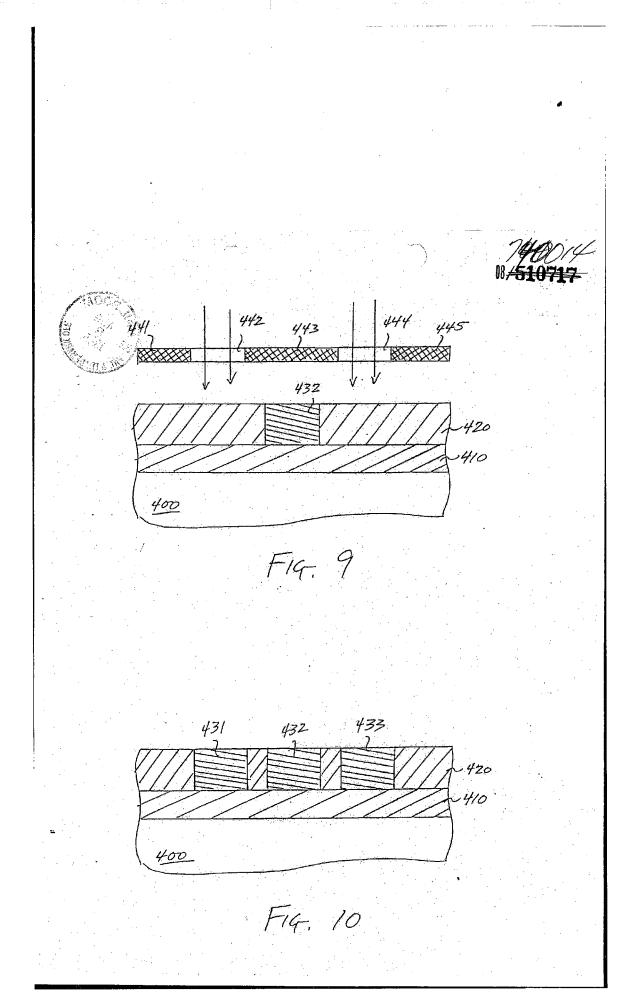


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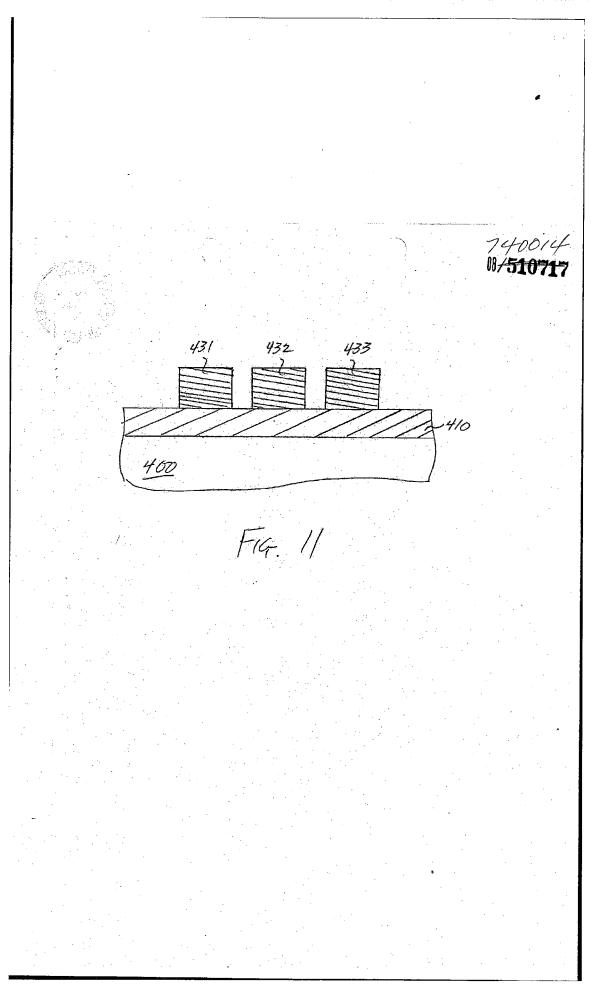
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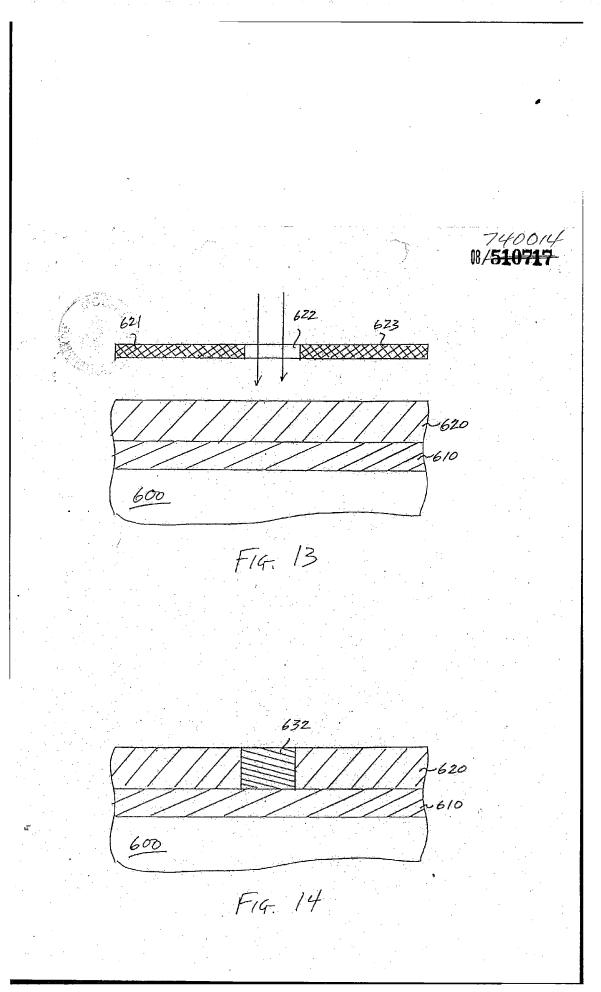


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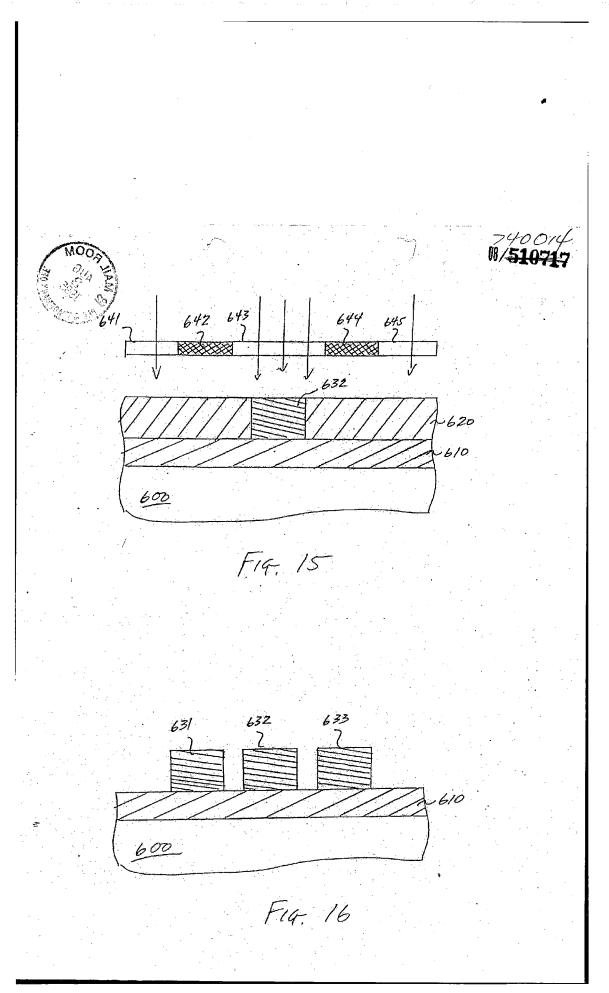


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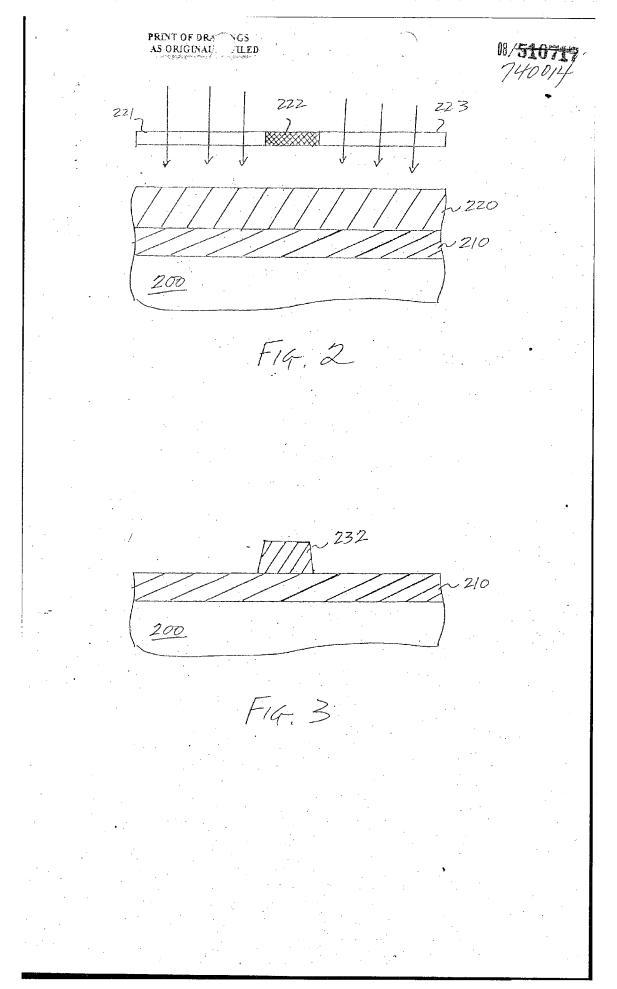


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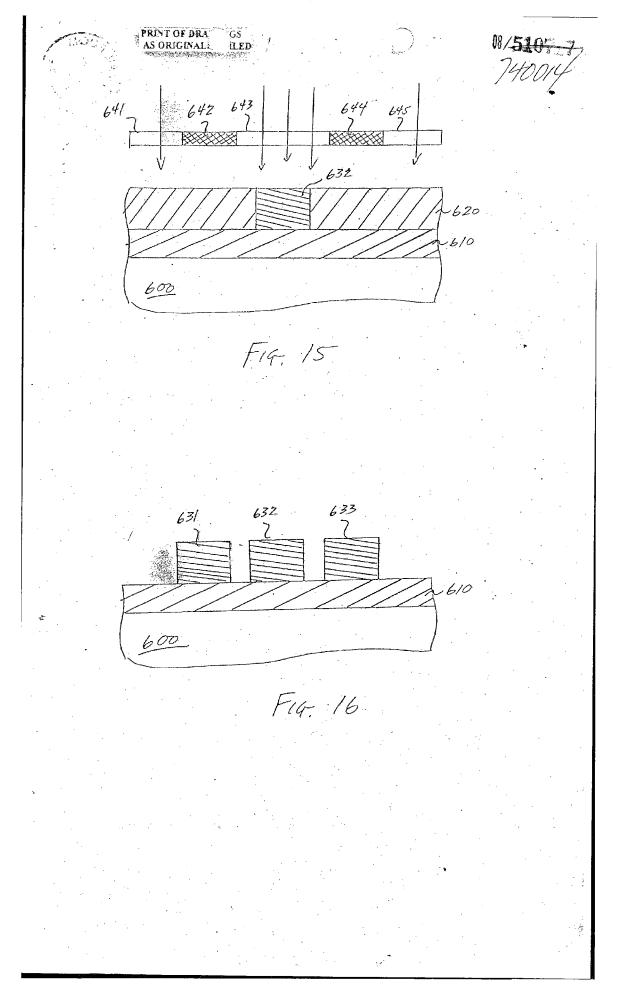
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Patent

Duda, K.

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Examiner:

Art Unit:

THE UNITED STATES PATENT AND TRADEMARK OFFICE

pplication of:

James M. Cleeves

Serial No.:

622

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.

BLÂKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date:

Respectfully submitted,

12400 Wilshire Boulevard Seventh Floor Los Angeles, CA 90025-1026 (408) 720-8598 Michael A. Bernadicou Reg No. 35,934

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INFORMATION DISCLOSURE CITATION						N	James M. Cleeves								
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32	A Vitomey's Docket No.: <u>16820, P048D</u>	Patent A
The Party	1995 IN THE UNITED STATES PATENT AND TRA	
	Patents and Trademarks Ex	rior Application:
	Washington, D.C. 20231 Ar	rt Unit: <u>1507</u>
	SIR: This is a request for filing a	
	Continuation application	Divisional application
	under 37 C.F.R. § 1.60 of pending prior application serial no. <u>08/361</u> filed on December 22, 1994	1,595,
	of James M. Cleeves	
	(inventor(s) currently of record for prior application	n)
. *•	forMETHOD FOR REDUCED PITCH LITHOGRAPHY	······································
· · ·	<u>X</u> 1. Enclosed is a complete copy of the specification (including claims), the the signature or an indication that if amendment referred to in the oath the application. (See below for drawerify that the attached papers are application serial no. <u>08/361.595</u> December 22, 1994	o oath or declaration showing t was signed, and any or declaration filed to complete <u>awing requirements.</u> ) I hereby a true copy of the prior
	<u>X</u> 2. Copies of the drawings filed in the	prior application are enclosed
	herewith.	
	3. Transfer the drawings from the prior applic as of the filing date accorded this applicatio	on. A duplicate copy of this sheet is
	enclosed for filing in the prior application file person authorized by 37 C.F.R. § 1.138 an	e. (May only be used if signed by
	4. New formal drawings are enclosed.	, , , , , , , , , , , , , , , , , , ,
	5. The filing fee is calculated below:	
	CLAIMS AS FILED IN THE PRIOR APPLICATION LESS ANY CL BELOW	
2	(Col. 1) (Col. 2) SMALL E	OTHER THAN A
	For: No. Filed No. Extra Rate	Fee Rate Fee
	Basic Fee:	365 \$ 730
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	Indep. Claims: 1 -3 * -0- x 38 \$	× 76 \$0-
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ж	"Express Maii" mailing label number <u>TB907642373US</u> Date of Deposit <u>8-3-45</u>	
	I hereby certify that this paper or fee is being deposited with the United Sta Office to Addressee' service under 37 CFR 1.10 on the date Indicated abor of Patents and Trademarks, Washington, D.C. 20231.	ates Postal Service "Express Mail Post ve and is addressed to the Commissioner
	Alice Tam (Typed of printed name of person mailing paper of tee)	
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	(Signature of person/mailing paper or fee)	
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	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).	
		such status is still proper and desired. Or 0.1 int. § 1.20(d).	
	<u>X</u> 7.	The Commissioner is hereby authorized to charge any fees that may be required,	
		or credit any overpayment, to Deposit Account No. <u>02-2666</u> . A duplicate copy of	
		this sheet is enclosed.	
	<u>    X                                </u>	A check in the amount of \$_730.00 is enclosed for the filing fee.	
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	9	A check in the amount of \$ is enclosed for the petition fee	
		pursuant to 37 C.F.R. § 1.17.	
	<b>X</b> 10.	Cancel in this application original claims 1-11	
ł		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.)	
	<u>X</u> 12.	Amend the specification by inserting the following before the first sentence on the	
		first page:	
NI	X	(a) - Thisis a continuation/X divisional of application	
$ V\rangle$		serial no contra data diled divisional of application serial no 08/361.595 filed December 22, 1994	
- \ .	<del></del>	(b) -, which is a continuation/ divisional of application serial no,	
		appication serial no, filed,	
ł		······································	
		(list all prior applications)	
	<u>X</u> 13,	It is hereby requested that any request for a convention priority made in the prior	
	<u> </u>	application be transferred to this Rule 60 application.	
	·		
	14.	The prior application is assigned of record to:	
	<u>X</u> 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	
	х	(a) The Power appears in the original papers of the prior application	
		serial no. <u>08/361,595</u> filed <u>December 22, 1994</u> .	
		(b) Because the Power does not appear in the original papers, a copy of the Davias in the mission profession is considered.	
	1	the Power in the prior application is enclosed.	
1		(c) Recognize as an associate attorney or agent and address all future	
		communications to:	
1		(Name) (Reg. No.)	
		BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN	
		12400 Wilshire Blvd., Seventh Floor	
		Los Angeles, California 90025 (408) 720-8598	
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18.

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.

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.

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,

8/3/9 Date:

Michael A. Bernadicou By

BLAKELY SOKOLOFF TAYLOR & ZAFMAN

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)

Reg. No. \_\_35.934

IPR2014-01030 / TSMC-1018 Page 74 of 178

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

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SERIAL NUMBER       FILMS DATE       FIRST MAKED INVENTOR       ATTORNEY DOCKET NO         08/510.717       08/03/95       CLEEVES       J       16820.P048D         08/510.717       08/03/95       CLEEVES       J       16820.P048D         08/510.717       08/03/95       CLEEVES       J       16820.P048D         12400       MILLENTE BOULEVARD       ATTUNT       PAPER JUMBER         2580       J       10520.P048D       This action is compared and the compared of your application.         COMMASSIONER OF PATENTS AND TRADEMARKS       J       I1/23/95       This action is mader.         Attorned attutory period or imports to this action is application.       Sommalian in the sentence in sharps of your application.       This action is mader.       J       Intermediation from the date of this inter.         Part THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:       1       Some informance. The period for response will also be application.       Some informance. The part of the paper application.       This action is mader.       Some informance. The period for response in the application.       Some informance. The period for response in the application.       Some informance. The date of the informance.       Some informance. The date of the part of the period for response in the application.       Some informance.       Some informance.       Some informance.       Some informance.       Some informance.			UNITED STATES DEPART Patent and Trademark Of Address: COMMISSIONER OF PAT Washington, D.C. 2023	<b>fice</b> ENTS AND TRADEMARKS
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Fature to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133         Part1 THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:         1. Matche of References Cited by Examiner, PTO-882.         3. Motioe of Art Cited by Applicant, PTO-1494.         5. Information on How to Effect Drawing Changes, PTO-1474.         9. Claims         1. Claims         1. Claims         2. Claims         2. Claims         3. Claims         3. Claims         3. Claims         4. Claims         4. Claims         4. Claims         4. Claims         5. Claims         6. Claims         7. Claims         7. This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.         8. Claims         9. The corrected or Subetitute drawings have been received on         10. The proposed drawing shave been received on the of Draftsmark Patent Drawing Review, PTO-452.         11. The proposed drawing shave been received on         12. Acknowledgement is made of the claim of the above, claims         13. Claims         14. Claims         15. Claims         16. Claims         17. This application has been filed with informal drawings under 37	· · · · · · · · · · · · · · · · · · ·		3	-
1. Matice of References Cited by Examiner, PTO-892.       2. Notice of Ar Cited by Applicant, PTO-149.         2. Information on How to Effect Drawing Changes, PTO-1474.       4. Notice of Informal Patent Application, PTO-152.         2. Match and the effect Drawing Changes, PTO-1474.       4. Notice of Informal Patent Application, PTO-152.         3. Claims       1.2 - 2.2.       are pending in the application of the above, claims         2. Claims       1.2 - 2.7.       are withdrawn from consideration or a stress of the above, claims         3. Claims       1.2 - 7.7.       are rejected.         5. Claims       1.2 - 7.7.       are rejected.         6. Claims       1.2 - 7.7.       are rejected.         7. This application has been filed with Informal drawings under 37 C.F.R. 1.85 which are acceptable to restriction or election requirement.       are objected to.         8. Formal drawings are required in response to this Cifice action.       Under 37 C.F.R. 1.84 these drawings are claopetable (Claims in purposes.         9. The corrected or substitute drawings have been received on				
2. ▲ hotoe of Art Cited by Applicant, PTO-1449.   5. ■ Information on How to Effect Drawing Changes, PTO-1474   Pert II SUMMARY OF ACTION   1. ▲ Claims _ /2 - 2.2.   0 the above, claims	Part I THE FOLLOWING ATTACHM	IENT(S) ARE PART OF THIS ACT	TION:	
S.       Intermation on How to Effect Drawing Changes, PTO-1474.       6.         Pert II SUMMARY OF ACTION			_	
Part I       SUMMARY OF ACTION         1. So Claims				ent Application, PTO-152.
1. Claims       12 - 22       are pending in the applica         Of the above, claims       are withdrawn from consideration         2. Claims       1 - 11       have been cancelled.         3. Claims       are rejected.         5. Claims       if 2 - 72         are rejected.       are rejected.         6. Claims       are objected to.         6. Claims       are objected to.         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				
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<ul> <li>6. Claims</li></ul>		·	· · · · · · · · · · · · · · · · · · ·	
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<ul> <li>8. Formal drawings are required in response to this Office action.</li> <li>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).</li> <li>10. The proposed additional or substitute sheet(s) of drawings, lifed on has (have) been has (have) been has (have) been approved by the examiner; disapproved by the examiner (see explanation).</li> <li>11. The proposed drawing correction, filed, has been has been has (have) been approved (see explanation).</li> <li>12. Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has been received not been receive ifled on</li> <li>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.</li> <li>14. Other</li> </ul>		-		
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; disapproved by the examiner (see explanation).         11.       The proposed drawing correction, filed, has been, has been, has (have) been approved (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 received hot been received         13.       Since this application appears 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	· · ·		C.F.H. 1.85 which are acceptable for ex	amination purposes.
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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).

-2

#### 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.

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 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.

- 4

kad 11-27-95

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.

KATHLEEN DUDA PRIMARY EXAMINER GROUP 1500 // 00

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	DOCUMENT NO.	DATE			NAME	<u>`</u>	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
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Patent Attorney's Docket No.: \_\_\_16820.P048D In re the Application of: \_\_\_James M. Cleeves (inventor) Application No.: \_\_08/510.717 led: August 3, 1995 RÖ METHOD FOR REDUCED PITCH LITHOGRAPHY (title) MAR MMISSIONER OF PATENTS AND TRADEMARKS ton, D.C. 20231 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: OTHER THAN A (Col. 1) (Col. 2) (Col. 3) SMALL ENTITY SMALL ENTITY Claims Highest No. Additional Remaining Previously Present Additional After Amd. Paid For Rate Rate Extra Fee Fee Total 1.6 Minus \*\* 20 ٥ x1.1 \$ x22 \$ -0-Claims Indep. \*\*\* x78 3 x39 \$ \$ Minus 3 0 -0-Claims First Presentation of Multiple +125 +250 \$ \$ Dependent Claim(s) If the entry in Col. 1 is less than the entry in Col. 2, write "0" in Col. 3. Total Total -0-\$ \$ Add. Fee Add. Fee 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). Acheck 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. 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): Any additional filing fees required under 37 C.F.R. § 1.16 for presentation of extra claims. Any extension or petition fees under 37 C.F.R. § 1.17. Respectfully Submitted, BLAKELY SOKOLOFF TAYLOR & ZAFMAN Date: FEBRUARY Ň 1996 Roland B. Cortes 12400 Wilshire Boulevard Seventh Floor Reg. No. 39,152 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 February 28, 1996 'nn Date of Deposit Dukie G. Stinson Name of Person Malling Correspondence Dullie 5-5-1-50 February-28, 1994 Signature Date (LJV/oak 10/02/95)

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Our Docket No.: 16820.P048D

Art Group: 1113

Serial No.: 08/510,717

Filed: August 3, 1995

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

# 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.

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# IN THE CLAIMS

Please amond Claim 12. Please add new Claim 23 - 28.

Attorney's Docket No. 16820.P048D

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·· .	·		•
•	•		
-	i	12. (Amended) A lithography method for semiconductor fabrication using a	
-17	2	semiconductor wafer, comprising the steps of:	
, 67	3	(a) forming an imaging layer over the semiconductor wafer;	
7	4	(b) exposing a portion of the imaging layer to radiation in accordance	2
	5	with a first pattern;	
$\mathbf{p}$	6	(c) stabilizing the exposed portion of the imaging layer; and	
51	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.	
	10	tioser to one another man ispossible intough a single exposure to radiation.	
	1	23 (New) The lithography method of Claim 12, wherein said adjacent	
23	2	features comprise a plurality of disposable posts.	
Ζ.	-	tennete compliane a printing of employable poster	
	. <b>1</b> ·	24. (New) The lithography method of Claim 12, wherein said adjacent	· · ·
$\mathcal{L}^2$	1/2	features have a pitch which is not limited by a single exposure to radiation.	
$\mathcal{V}_{\mathbb{C}}$	-	reactives may a prior which is not minica by a single exposure to manufacture	·
	1	25. (New) A lithography method for semiconductor fabrication using a	
•	2	semiconductor water, comprising the steps of:	
	3	(a) forming an imaging layer over the semiconductor wafer;	
	4	<ul><li>(b) exposing a first portion of the imaging layer to radiation in</li></ul>	
•	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	<ul> <li>(f) developing the imaging layer to form a patterned layer.</li> </ul>	
		-2- Attorney's Docket No. 16820.P048D	

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- 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.

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

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.

Rejection of Claim 12 under 35 U.S.C. §112, first paragraph.

I.

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 radiationsensitive 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 <u>Haraguchi et al.</u>

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 <u>Haraguchi et al.</u> Applicant responds as follows.

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

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

patterned layer. In contrast to Claim 12 of the present invention, <u>Haraguchi et al.</u> discloses only one pattern which is not formed from a first and second pattern. Given that <u>Haraguchi et al.</u> 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, <u>Haraguchi et al.</u> 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, <u>Haraguchi et al.</u> does not disclose that the adjacent features are disposable posts as claimed in new Claim 23. Moreover, <u>Haraguchi et al.</u> 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 <u>Haraguchi et al.</u> 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, <u>Haraguchi et al.</u> does not disclose exposing a first portion of an imaging layer to radiation in accordance with <u>a first pattern</u>, and patterning the imaging layer in accordance with <u>a second pattern</u>, the imaging layer then being developed to form a patterned layer. In contrast to Claim 25 of the present invention, <u>Haraguchi et al.</u> discloses only one pattern which is not

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formed from a first and second pattern. Given that <u>Haraguchi et al.</u> 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, <u>Haraguchi et al.</u> does not disclose two stabilizing steps. That is, <u>Haraguchi et al.</u> does not disclose stabilizing an exposed first portion of an imaging layer, and stabilizing an exposed second portion of the imaging layer.

Third, <u>Haraguchi et al.</u> 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, <u>Haraguchi et al.</u> does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Moreover, <u>Haraguchi et al.</u> 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 <u>Haraguchi et al.</u> 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 <u>Tsuji et al.</u>

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 <u>Tsuji et al.</u> Applicant responds as follows.

# 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 <u>Tsuji et al.</u> <u>Tsuji et al.</u> 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. <u>Tsuji et al.</u> 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, <u>Tsuji et al.</u> does not disclose that the adjacent features are disposable posts as claimed in new Claim 23. Moreover, <u>Tsuji et al.</u> 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. <u>Tsuji et al.</u> 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 <u>Tsuji et al.</u> 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 <u>Tsuji et al.</u> <u>Tsuji et al.</u> does not teach, suggest, or disclose each and every element of Claim 25 as presently amended,

-7-

nor does any other reference provide these missing elements. <u>Tsuji et al.</u> 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. <u>Tsuji et al.</u> 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 <u>Tsuji et al.</u> that would motivate one skilled in the art to arrive at the lithography method of new Claim 25.

Additionally, <u>Tsuji et al.</u> 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, <u>Tsuji et al.</u> does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Furthermore, <u>Tsuji et al.</u> 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 <u>Tsuji et al.</u> 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.

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

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 <u>Maheras et al.</u> Applicant responds as follows.

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# 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, <u>Maheras et al.</u> does not disclose stabilizing the <u>exposed</u> portion of the imaging layer as claimed in step (c) of Claim 12 of the present invention; rather, <u>Maheras et al.</u> discloses surface hardening the <u>unexposed</u> areas of photoresist (column 6, lines 36-64). There is nothing taught, suggested, or described in <u>Maheras et al.</u> 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 <u>Maheras et al.</u> <u>Maheras et al.</u> 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.

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

Moreover, <u>Maheras et al.</u> 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, <u>Maheras et al.</u> 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 <u>Maheras et al.</u> disclose a single patterned layer not formed

-10-

from a first and second patterned layer. Additionally, it is Applicant's understanding that Figures 1A - 1D of <u>Maheras et al.</u> 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, <u>Maheras et al.</u> does not disclose that the adjacent features are disposable posts as claimed in new Claim 27. Furthermore, <u>Maheras et al.</u> 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.

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# <u>CONCLUSION</u>

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: BRUAN

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

Roland B. Cortes

Reg. No. 39,152

**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: Commissionel of Ratents and Irademarks, Washington, D.C. 20231 on: ULCL STINS 60. Florence 8, 1996

February 28, 1996

Name : Dulcie Stinson

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IPR2014-01030 / TSMC-1018 Page 94 of 178

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

220-126

Examiner:

Art Unit:

Patent Application of:

James M. Cleeves

Application No.: 08/510,717

Filed: August 3, 1995

Sir:

METHOD FOR REDUCED PITCH For: LITHOGRAPHY

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

### **INFORMATION DISCLOSURE STATEMENT**

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):

Disclosure Statement is one of the following:

37 C.F.R. §1.97(c). If so, then enclosed with this Information

37 C.F.R. §1.97(b).

X :

020 JH 04/24/96 08510717

220.00 CK 1 126

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

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.

2

Respectfully submitted, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: \_\_\_ APRA 16

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

Roland B. Cortes Reg. No. 39,152

EIBST 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 1/2, 1996

Date of Deposit fin Name: Dulcie G. Stinson Date

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Part II SUMMARY OF A	CTION			f .	
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Of the above				are withdrawn fro	
2. Claims				have been c	ancelled.
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7. This application ha		drawings under 37 C.F.R.		table for examination purpos	•
9. The corrected or s	ubstitute drawings have be ;	een received on		Under 37 C.F.R. 1.84 the ing Review, PTO-948).	se drawings
	ditional or substitute sheet( approved by the examiner		has	(have) been 🔲 approved b	by the
11. The proposed draw	wing correction, filed	, has t	been ⊡approved; D	disapproved (see explanat	ion).
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Page 100 of 178

Art Unit: 1113

1.

Claims 12-28 are pending in this application.

### Specification

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.

-2

Art Unit: 1113

#### Claim Rejections - 35 USC § 102

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.

-3-

Art Unit: 1113

### 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.

 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

-5-

Art Unit: 1113

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** 

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2) Roland Cortes		(4)				
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Claims: Indep. Claims: Fire **If the d	after amendanent 18 r 2 r st presentation of ifference in Col.2 i A check in til Applicant(s) C.F.R. § L.I A check for Please charge copy of th The Commin with this cor	ninus Multiple is less tha he amou hereby 136(a). \$11 ye my D is shea ssioner mmunic	3 Dependent C p zero, eater " mt of Petition(s) 0.00 is peposit Accord et is enclo is hereby at ation or cre-	0 atim(s) 0" in Col. 3 \$0.00 for an Externation s attached from the state of t	x \$39.00= + \$125.00 Total Add. Fee: is attached fc nsion of Time or processing <u>2-2666</u> the arr charge paym rpayment to I	\$0.00 \$0.00 \$0.00 of presentation of <u>ONE</u> fees under 37	x \$78.00= + \$250.00 Total Add. Fee: of additional month(s) p C.F.R. § 1.17 A d wing fees ass	\$0.00 \$0.00 \$0.00 claim(s). bursuant to 37 7. uplicate ociated
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110-115 Docket No.: 16820.P048D iev Patent IN THE UNITED STATES PATENT AND TRADEMARK OFFICE In re Application of: RECEIV 5 1996 100 **James M. Cleeves** Examiner: Duda, K. **GROUP 1100** Serial No.: 08/510,717 Art Group: 1113 🗡 Filed: August 3, 1995 Ihereby cardly that this correspondence is being deposited w the United States Postal Service as first class mail with suffice postage in an envelope addressed to the Commissioner of Pat METHOD FOR REDUCED PITCH For: 20231 LITHOGRAPHY 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: Sentemper 24\_,1996

Roland B. Cortes Reg. No. 9,152

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

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# 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

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# 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.

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Respectfully submitted, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: JEARENBER 24 1996

Roland B. Cortes Reg. No. 9,152

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

> IPR2014-01030 / TSMC-1018 Page 110 of 178

Docket No.: 16820.P048D Patent AMENDMENT UNDER 37 C.F.R. § 1.116 EXPEDITED PROCEDURE EXPEDITED 1113 EXAMINING CONFILIP 1113 and Mail IN THE UNITED STATES PATENT AND TRADEMARK C In re Application of: OCT 5 1996 James M. Cleeves Examiner: Duda, K. GROUP 1100 Serial No.: 08/510,717 Art Group: 1113 Filed: August 3, 1995 the United States Postal Service as first class ope address postage in an env For: METHOD FOR REDUCED PITCH and Trademarks, Washington, D.C. 20231 LITHOGRAPHY 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. (Twice Amended) A lithography method for semiconductor fabrication 12. using a semiconductor wafer, comprising the steps of: (a) forming an imaging layer over the semiconductor wafer; (b) exposing a portion of the imaging layer to radiation in accordance 5 with a first pattern to form a first feature; 6 (c) stabilizing the exposed portion of the imaging layer; and Ser. No. 08/510,717 16820.P048D - 1 -

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 <u>to form a first feature</u> ;
	Ser. No. 08/510,717 - 2 - 16820.P048D

IPR2014-01030 / TSMC-1018 Page 112 of 178 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];

(e) stabilizing the exposed second portion of the imaging layer; and
(f) developing the imaging layer to form a patterned layer, wherein the
first and second features are formed relatively closer to one another than is
possible through a single exposure to radiation.

27. (Once Amended) The lithography method of Claim 25, wherein the
 [patterned layer comprises a plurality of] <u>the first and second features comprise</u>
 disposable posts[, each disposable post being formed relatively closer to other

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

28. (Once Amended) The lithography method of Claim 25, wherein the
 [patterned layer has adjacent features, the adjacent] <u>the first and second</u> features

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

Please add new claims 29 and 30.

29. (New) The lithography method of Claim 12, wherein the first and
 second features do not overlap.

1 30. (New) The lithography method of Claim 25, where the first and 2 second features do not overlap.

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### <u>REMARKS</u>

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<sub>11</sub>, 30<sub>12</sub>, and 30<sub>2</sub> in layer 26. (see also column 4, lines 27-31). Figures 3C-3K illustrate that portions 30<sub>11</sub>, 30<sub>12</sub>, and 30<sub>2</sub> are further processed in order to create contact holes 39<sub>1</sub>, 39<sub>2</sub>, 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

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second feature distinct from the first feature. As described above, Haraguchi forms portions 3011, 3012, and 302 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

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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

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Ser. No. 08/510,717

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.

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Ser. No. 08/510,717

# **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: JEATEMBER 24 1996

Roland B. Cortes Reg. No. 39,152

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

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<ul> <li>2. Please enter the preliminary amendment enclosed before calculating the filing fee.</li> <li>3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on <u>September 30, 1996</u> under 37 C.F.R. § 1.116, but unentered, in the parent application.</li> <li>"Express Mail" mailing label number <u>EM531594550US</u></li> <li>Date of Deposit <u>October 22, 1996</u></li> <li>Thereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addresse under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.</li> <li><u>Anne Gemetize</u> (Typed or pinted Agne of person mailing paper or fee)</li> <li><u>UMM</u> <u>Math 10/23746</u> (8510747)</li> </ul>		under 37 C.F.R. § 1.62(g) Please use all the conten the drawings, as the basic the prior application is ir	as of the filing dat ts of the prior appli papers for the new icluded herewith. T	e of this new application cation file wrapper, inclu- application.• <u>No such c</u> he present application is	n. uding opy of
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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).

5. The filing fee is calculated below:

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X

(a)

(b)

11.

	(Col. 1)	(Col. 2)		ENTITY		R THAN A	
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	
	·	laim(s) Presented	+130	\$	+260	\$	
* If the difference enter "0" in Co	e is less than zer d. 2.	ro,	TOTAL	\$	TOTAL	\$ 770	
7T	is enclose s still proper a he Assistant Co equired, or credi	ent to establish small ofwas file nd desired. 37 C.f mmissioner is hereby t any overpayment, to f for Deposit Account	d in the pe F.R. § 1.20 authorized Deposit /	nding prior a 8(a). I to charge a Account No. (	pplication a	and such si may be	
X8. A	check in the amo	unt of \$ 770.00		is enclosed	for the filing	l fee.	

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

9. A check in the amount of \$\_390.00 is enclosed for the petition fee pursuant to 37 C.F.R. § 1.17.

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

- This is a XX\_\_\_\_\_ continuation/\_\_\_\_\_\_ divisional of application no. \_\_\_\_\_08/510.717\_\_\_, filed \_\_\_\_08/03/95\_\_\_\_, now abandoned. --

-, 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)

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

- 2 -

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

12.	Priority of foreign application number
	n (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:
14.	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
<u> </u>	(a) The Power appears in the original papers of the prior application
	no. <u>08/510.717</u>
<u> </u>	(b) The Power does not appear in the original papers, but was filed on
	in prior application no
-	fied
<u> </u>	(c) A new Power has been executed and is attached.
v	
<b>^</b>	<ul> <li>(d) Recognize as an associate attorney or agent and address all future communications to:</li> </ul>
	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
<u>X</u>	(e) Address all future communications to the undersigned.
	n an an an ann an Arlanda. An ann an Arlanda ann a Arlanda ann an Arlanda
15.	Enclosed is a photocopy of a petition for an extension of time
1	pursuant to 37 C.F.R. § 1.136 concurrently (or previously) submitted under separate cover for the above-referenced prior application.
s .	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,
<u></u>	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 filling of an application under 27 O F D P 1 CO will be described to be lude a water
<u> </u>	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
	-3 - LJV/cak (10/01/96) Rule 62
1.1	

IPR2014-01030 / TSMC-1018 Page 123 of 178 concerning either the prior application or any continuing application filed under the provisions of 37 C.F.H. § 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).

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

18:

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

By Roland B. Cortes

Reg.No. 39,152

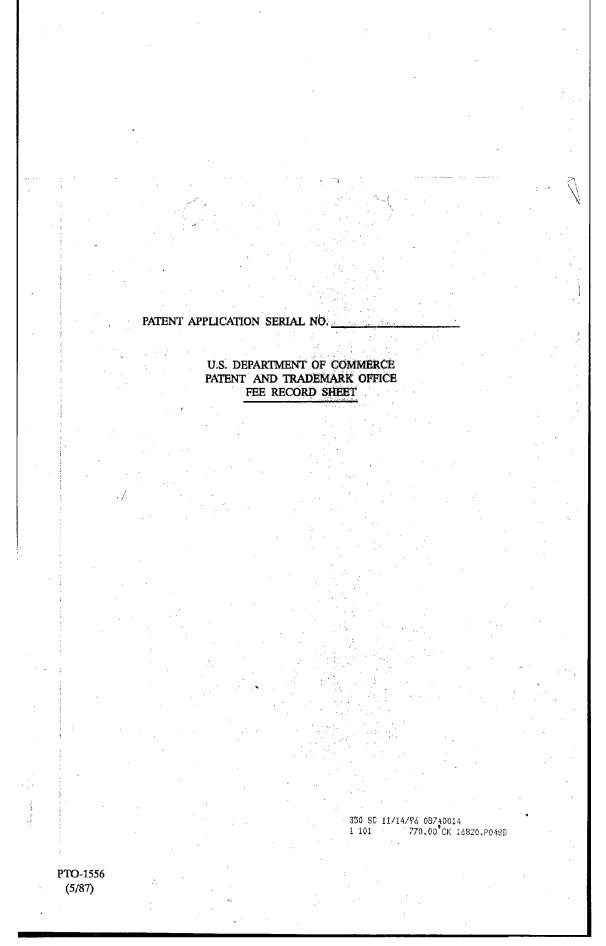
Attorney or Agent of Record

\_ Associate Attorney or Agent

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

IPR2014-01030 / TSMC-1018 Page 124 of 178

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



IPR2014-01030 / TSMC-1018 Page 125 of 178

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JAMES M. CLEEVES,	REDWOOD CITY,	CA.			
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**CONTINUING DATA* VERIFIED THIS	******************** APPLN IS A DI WHICH IS A DI	V OF 08/5	10,717 08/03/9 61,595 12/22/9	5 4	. * - s*
**FOREIGN/PCT APPL VERIFIED	ICATIONS*****	****			
VERIFIED		*****			
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VERIFIED FOREIGN FILING LIC	ENSE GRANTED 1		FILING FEE RECEIVED \$770.00	ATTORNEY DOCKET N 16820.F048D	10.
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ney Docket No.: 16820.P048D AMENDMENT UNDER .R. § 1.116 EXAMINING GROUP 1113 EXAMINING GROUP 1113 EXPEDITED PROCEDURE IN THE UNITED STATES PATENT AND TRADEMARK OF REC In re Application of: OCT 5 1996 James M. Cleeves Examiner: Duda, K. GROUP 1100 Serial No.: 08/510,717 Art Group: 1113 Filed: August 3, 1995 vice as first d For: METHOD FOR REDUCED PITCH Washington, D.C. 2023 LITHOGRAPHY 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 capcel claim 26. Please amend claims, 12, 20, 23, 24, 25, 27, and 28 as follows. 12. (Twice Amended) A lithography method for semiconductor fabrication using a semiconductor wafer, comprising the steps of: (a) forming an\imaging layer over the semiconductor wafer; (b) exposing a portion of the imaging layer to radiation in accordance with a first pattern to form a first feature; (c) stabilizing the exposed portion of the imaging layer; and Ser. No. 08/510,717 16820.P048D -1

(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 [to form] forming a patterned layer, [said second pattern being different than said first pattern], wherein the [patterned layer has adjacent features which] the first and second features are formed relatively closer to one another than is possible through a single exposure to radiation.

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(Once Amended) 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, and

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

(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.

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

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

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

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

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accordance with a first pattern to form a first feature;

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stabilizing the exposed first portion of the imaging layer; (c) (d) exposing a second portion of the imaging layer in accordance with a second pattern to form a second feature distinct from the first feature[, wherein said second pattern is different than said first pattern];

(ė) stabilizing the exposed second portion of the imaging layer; and (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.

27. (Once Amended) The lithography method of Claim 25, wherein the [patterned layer complises a plurality of] the first and second features comprise disposable posts[, each disposable post being formed relatively closer to other disposable posts than is possible through a single exposure to radiation].

28. (Once Amended) The lithography method of Claim 25, wherein the [patterned layer has adjacent features, the adjacent] the first and second features [having] have a pitch which is not limited by a single exposure to radiation.

Please add new claims 29 and 30.

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

2 second features do not overlap.

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15 (New) The lithography method of Claim 28, where the first and second features do not overlap.

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### **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<sub>11</sub>, 30<sub>12</sub>, and 30<sub>2</sub> in layer 26. (see also column 4, lines 27-31). Figures 3C-3K illustrate that portions 30<sub>11</sub>, 30<sub>12</sub>, and 30<sub>2</sub> are further processed in order to create contact holes 39<sub>1</sub>, 39<sub>2</sub>, 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

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second feature distinct from the first feature. As described above, Haraguchi forms portions 3011, 3012, and 302 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

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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

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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.

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# **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.

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Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

EPTEMBER 24 Dated: \_\_\_ 1996

Roland B. Cortes Reg. No. 39,152

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

Ser. No. 08/510,717

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••	IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	•
- 1	Assistant Commissioner for Patents     Prior Application: 08/510.717       Washington, D.C.     20231       BOX FWC     Art Unit:	
•	<u>RULE_62</u>	
· .	Sir: This is a request for filing a file wrapper	
	Continuation application	
	under 37 C.F.R. § 1.62 of pending prior nonprovisional application no08/510.717	
	filed on <u>August 3, 1995</u>	
	of James M. Cleaves	
•	(inventor(s) currently of record for prior application)	÷ .
	for METHOD FOR REDUCED PTTCH LITHOGRAPHY (itile)	
Q	1. The above-identified prior application is hereby expressly abandoned	•
-	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	
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	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. 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on <u>September 30, 1996</u> under 37 C.F.R. § 1.116, but	
	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. 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on <u>September 30, 1996</u> under 37 C.F.R. § 1.116, but	
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and the second s	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. 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on <u>September 30, 1996</u> under 37 C.F.R. § 1.116, but unentered, in the parent application.  *Express Mail* mailing label number <u>EM531594550US</u> Date of Deposit_ <u>October 22, 1996</u> I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee for an or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee under 37 C.F.R 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.	
and the second s	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. 3. Before calculating the filing fee, please enter in the present application the Amendment After Final filed on <u>September 30, 1996</u> under 37 C.F.R. § 1.116, but unentered, in the parent application. 	
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of the prior application Cancel in this application claims, before calculating the filing fee (wherein at least one independent claim is retained for filing purposes). 5. The filing fee is calculated below: CLAIMS NOW PENDING IN THE PRIOR APPLICATION PLUS/MINUS CLAIMS ADDED/CANCELED ABOVE OTHER THAN A (Col. 2) SMALL ENTITY SMALL ENTITY (Col. 1) For: No, Filed No. Extra Rate Fee Rate Fee Basic Fee: 385 770 x 22 Total Claims: 18 0 0 20 x 11 Indep. Claims: 2 з 0 x-40 x 80 0 Multiple Dependent Claim(s) Presented +130 ŝ +260 Ś If the difference is less than zero, TOTAL TOTAL \$ 770 \$ enter "0" in Col. 2, Ó Ó A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 6 1400 was filed in the pending prior application and such status is enclosed/\_\_\_\_ is still proper and desired, 37 C.F.R. § 1.28(a). The Assistant Commissioner is hereby authorized to charge any fees that may be х 7. ÷+ required, or credit any overpayment, to Deposit Account No. 02-2666. A duplicate of this sheet is enclosed for Deposit Account purposes. -A check in the amount of \$\_770.00 is enclosed for the filing fee. 8 Q 71 A check in the amount of \$ 390,00 is enclosed for the petition fee pursuant ų to 37 C.F.R. § 1.17. ¢ Amend the specification by inserting the following before the first sentence on the first 10 話 page: (a) -Thisisa<u>XX</u> continuation/ divisional of application now abandoned which 08/510,717 filed 08/03/95 no. (b) -, which is a continuation/\_ divisional of application XX no. 08/510.717 filed 08/03/95 now abandoned, (Status: abandoned, pending, etc.) (list all prior applications) It is hereby requested that any request for a convention priority made in the prior 11. application be transferred to this Rule 62 application. LJV/cak (10/01/96) Rule 62, - 2

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12.	Priority of foreign application number
	in (country) is claimed under 35 U.S.C. § 119.
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X13.	The prior application is assigned of record to:
<u>a                                    </u>	
	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:
	ELIWING TAYOF, Heg. No. 25, 129, and cenan other listed attorneys of agent(s) of:
• •	BLAKELY, SOKOLÖFF, TAYLOR & ZAFMAN LLP
	12400 Wilshire Blvd., Seventh Floor
	Los Angeles, California 90025
1. A.	(310) 207-3800
<u>K</u> .	(a) The Power appears in the original papers of the prior application
	no. 08/510,717 filed 08/03/95
1. E	
	(b) The Power does not appear in the original papers, but was filed on
· · ·	
	in prior application no.
	filed
1 x y 1	
<u></u>	(c) A new Power has been executed and is attached.
( )	(d) Recognize as an associate attorney or agent and address all future
	communications to:
· · ·	(Name) (Reg. No.)
	BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
	12400 Wilshire Blvd., Seventh Floor
	Los Angeles, California. 90025
	(408) 720-8598
•	
<u> </u>	(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.
( 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.
<u> </u>	The filling of an application under 97 C E D S 1 20 will be seen to all to instruct to
<u> </u>	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
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DEPARTA A DEESS

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).

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,

Roland B. Cortes

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

Date

18.

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

Charles Contractions and an

Reg.No. 39,152

\_\_\_\_ Attorney or Agent of Record

Associate Attorney or Agent

Filed Under 37 C.F.R. § 1.34(a)

LJV/cak (10/01/96) Rule 62 IPR2014-01030 / TSMC-1018 Page 138 of 178

UNITED STATES DEPARTMENT OF COMMERCE Patent and Trademark Office Address: COMMISSIONER OF PATENTS AND TRADEMARKS Washington, D.C. 20231 FIRST NAMED INVENTOR APPLICATION NO. FILING DATE ATTORNEY DOCKET NO. 10723796 16820.P048D 11M1/0107 Γ EXAMINER 7 BLAKELY SOKOLOFF TAYLOR AND ZAFMAN DUDA, K SEVENTH FLOOR 12400 WILSHIRE BOULEVARD PAPER NUMBE ART UNIT LOS ANGELES CA 90025 1113 01/07/97 DATE MAILED: 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

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A shor	tened statutory p	period for response to this	action is set to e	expire <u>thr</u>	ee month	(s), or thirty	days, which	ever
		ing date of this communica abandoned. (35 U.S.C. § 1						he
	R 1.136(a).	mandoned: 155 0.3.0.3	33). Extension	S OF GIRE FRA	y De Obtaine			
Disnos	ition of Claims	•						
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		Notice of Draftsperson's F	-					
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Serial Number: 08/740,014 Art Unic: 1113

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

-2-

Serial Number: 08/740,014 Art Unit: 1113

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 OLIDA PRIMARY EXAMINER **GROUP 1100** 

kad 1-6-97

> IPR2014-01030 / TSMC-1018 Page 142 of 178

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In re the Application of: <u>James M. Cleeves</u>		· · · · · · · · · · · · · · · · · · ·	
· · · · ·	(inventor(s))		
Application No.: 08/740.014	· · · · · ·		

Filed: October 23, 1996

AL ROA

METHOD FOR REDUCED PITCH LITHOGRAPHY For:

#### (titie)

#### 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. No additional fee is required.

The fee has been calculated as shown below:

	(Col. 1)		(Col. 2)	(Col. 3)
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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 Gemetzke Name of Person Mailing Correspondence Ĝ Date

-1-

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.

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. <u>02-2666</u> (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.

\_\_\_ Any extension or petition fees under 37 C.F.R. § 1.17.

-2-

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP

1997 Date

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

Х

Roland B. Cortes

Reg. No. 39,152



Patent

In re the Application of: \_\_\_\_\_ James M. Cleeves

Application No.: 08/740.014

(inventor(s))

Filed: \_\_October 23, 1996

METHOD FOR REDUCED PITCH LITHOGRAPHY For;

# 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.

(title)

A verified statement to establish small entity status under 37 C.F.R. §§ 1.9 and 1.27 is enclosed. No additional fee is required, Х

The fee has been calculated as shown below:

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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 9 Signatú Date

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IPR2014-01030 / TSMC-1018 Page 145 of 178

A check in the amount of \$ is	attached for presentation of additional claim(s).						
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19	74 ttomer Docket No.: 16820.P048DC Patent
TRAD	IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
	In re Application of:
	James M. Cleeves Examiner Duda, K.
	Serial No.: 08/740,014 Art Group: 1113
	Filed: October 23, 1996
	For: METHOD FOR REDUCED PITCH
	LITHOGRAPHY
	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
	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
· .	Anne Cemetzke
	Name of Person Mailing Correspondence
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# IPR2014-01030 / TSMC-1018 Page 147 of 178

(b) exposing a portion of the imaging layer to radiation in accordance
(c) stabilizing the exposed portion of the imaging layer; and
(d) patterning the imaging layer in accordance with a second pattern to
form a <u>plurality of second features</u> distinct from the first feature, the first and
second features forming a patterned layer, wherein the first feature is interposed
between two of the plurality of second features such that the first and second
features are formed relatively closer to one another than is possible through a

12 single exposure to radiation.

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

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

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

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

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

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

8 second pattern to form a <u>plurality of second features</u> 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

(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.

(Twice Amended) The lithography method of Claim 25, wherein the [the] first and second features comprise disposable posts.

Serial No.: 08/740.014

- 2 -

16820.P048DC

1 1 28. (Twice Amended) The lithography method of Claim 20, wherein the [the] first and second features have a pitch which is not limited by a single exposure to radiation.

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## 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, such that the first feature is

Serial No.: 08/740,014

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- 3 -

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,

Roland B. Cortes Reg. No. 39,152

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BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

3/1 Dated: 1997

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

Serial No.: 08/740.014

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Serial Number: 08/740,014

Art Unit: 1113

1.

# REASONS FOR ALLOWANCE

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 <u>13</u> and then forming second features <u>33, 34, 35</u>. 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."

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.

EXAMINER GROUP 1100

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> IPR2014-01030 / TSMC-1018 Page 152 of 178

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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

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APPLICATION NO. FILING DATE TOTAL CLAIMS EXAMINER AND GROUP ART UNIT DATE MAILED 08/740.014 10/23/96 918 DUDA, K 1113 06/02/97 First Named Applicant DLEEVES. JAMES M.

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			4 1	•			• <b>*</b>

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:

	Review the SMALL ENTITY status shown above.						
	If the SMALL ENTITY is shown as yes, verify your	с. 19 С. 19	요즘 영화 영화	1999	in firste ble	er state i	$(1,2,1)_{\rm eff}$
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B. If the status is the same, pay the FEE DUE shown B. File verified statement of Small Entity Status before, or with, above.

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PTOL-85 (REV. 05:98)(0851-0033) U.S. GPO: 1997-422-197/60032

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Patent

#### IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: James M. Cleeves

Serial No.: 08/740,014

Filing Date: October 23, 1996

For: METHOD FOR REDUCED PITCH LITHOGRAPHY

A Continuation of:

Application No.: 08/510,717

Filed: August 3, 1995

Batch No.:	N63	

Duda, K.

1113

Examiner:

Art Unit:

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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,

Date:

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLF

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

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Attorney's Docket No.: 16820.P048DC

Patent Patent

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Examiner:

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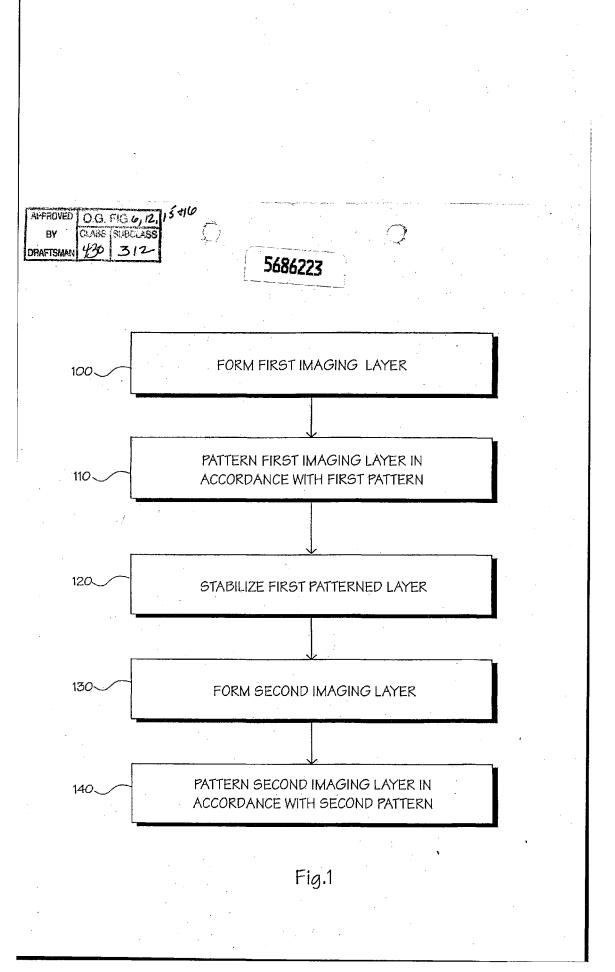
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IPR2014-01030 / TSMC-1018 Page 156 of 178

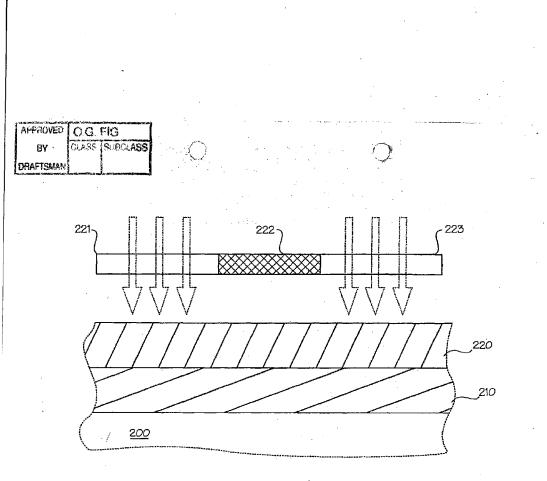
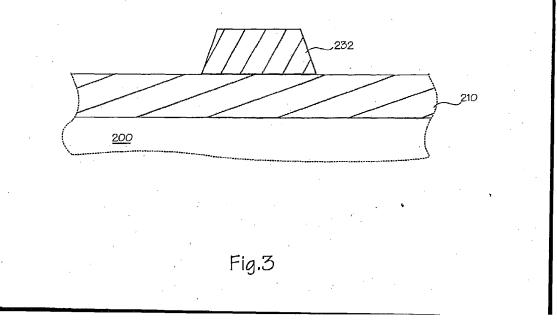


Fig.2



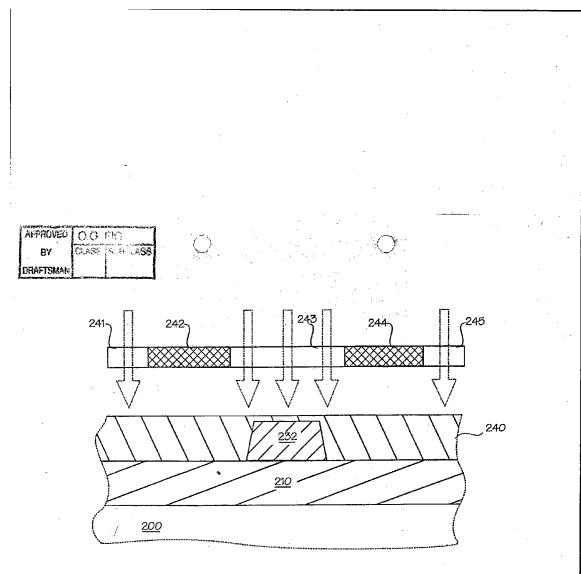
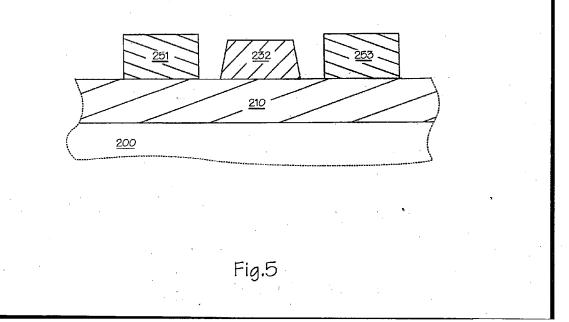
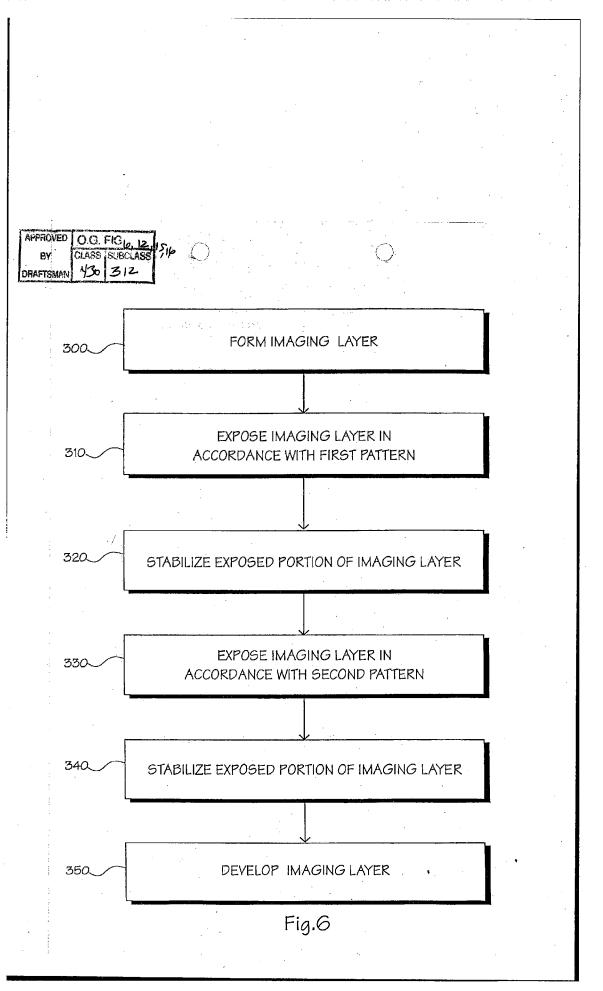


Fig4





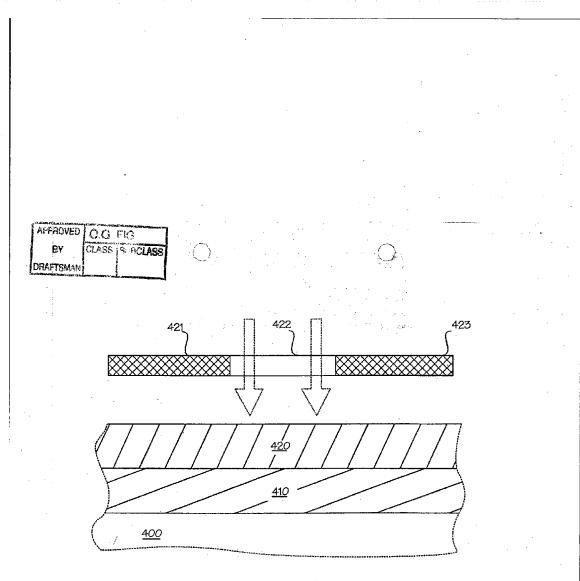
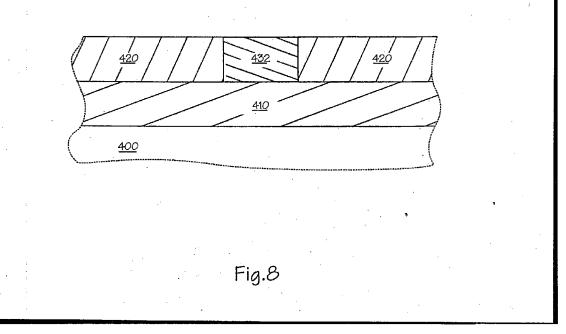


Fig7



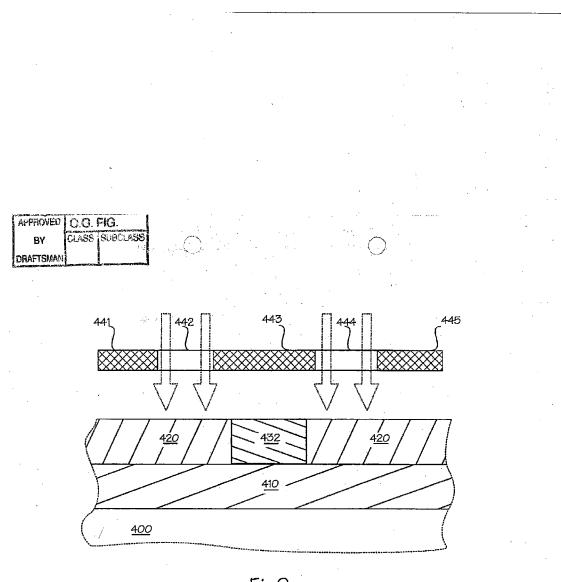
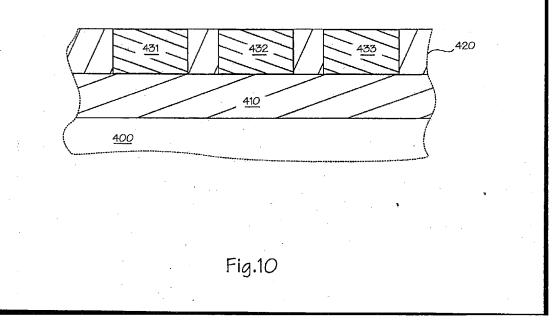
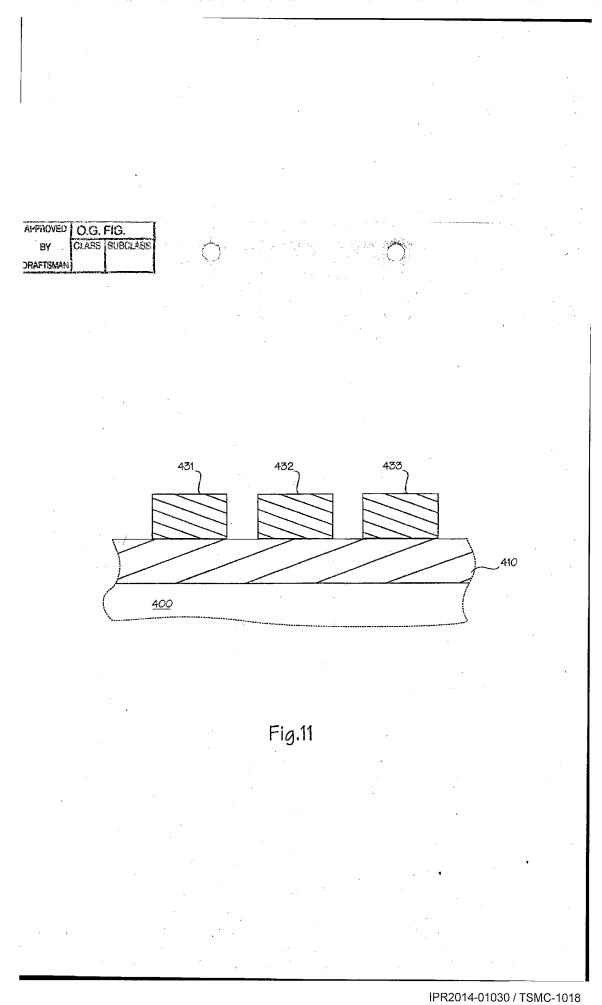
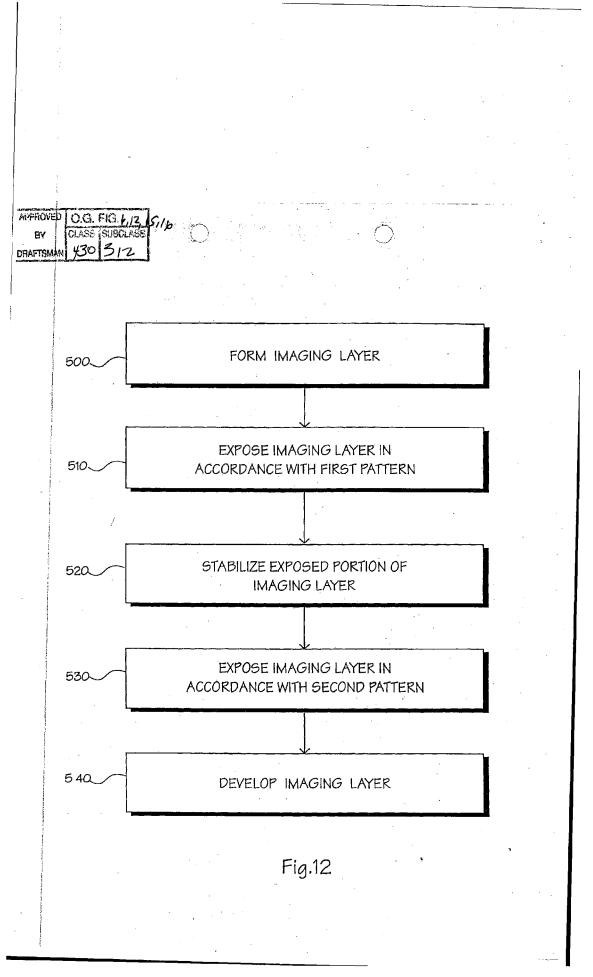


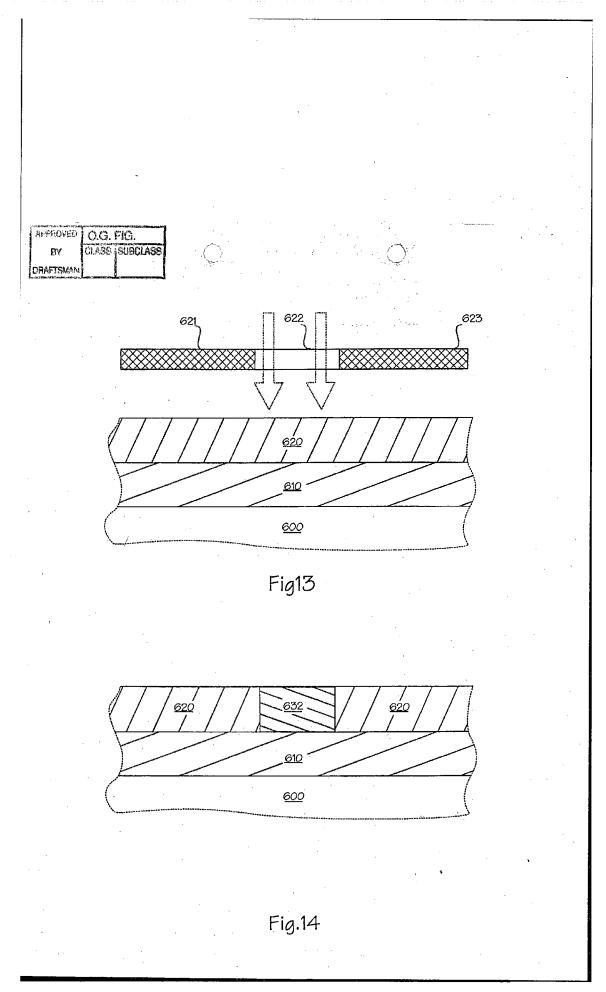
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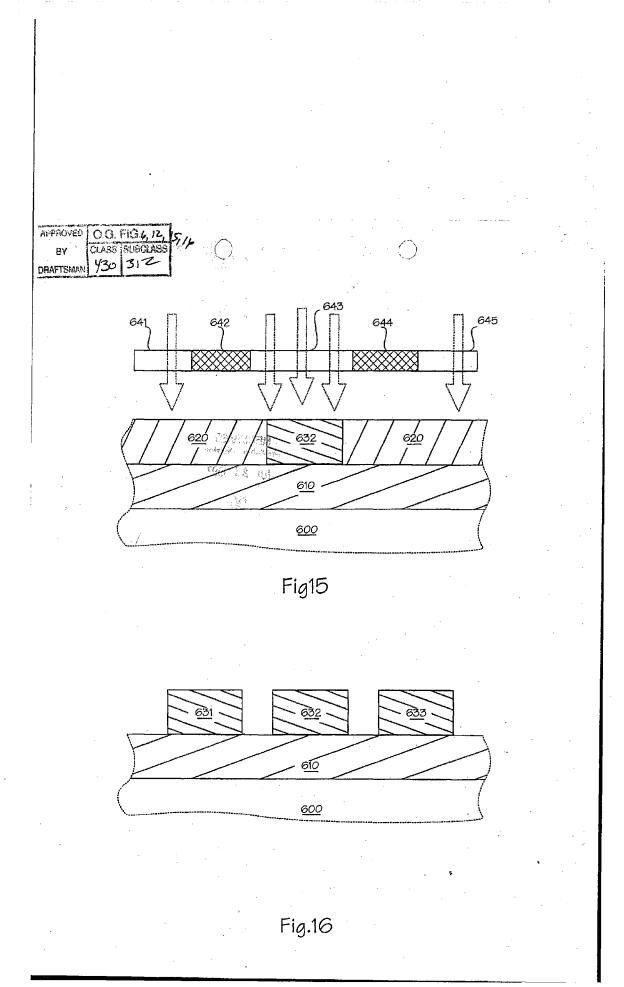


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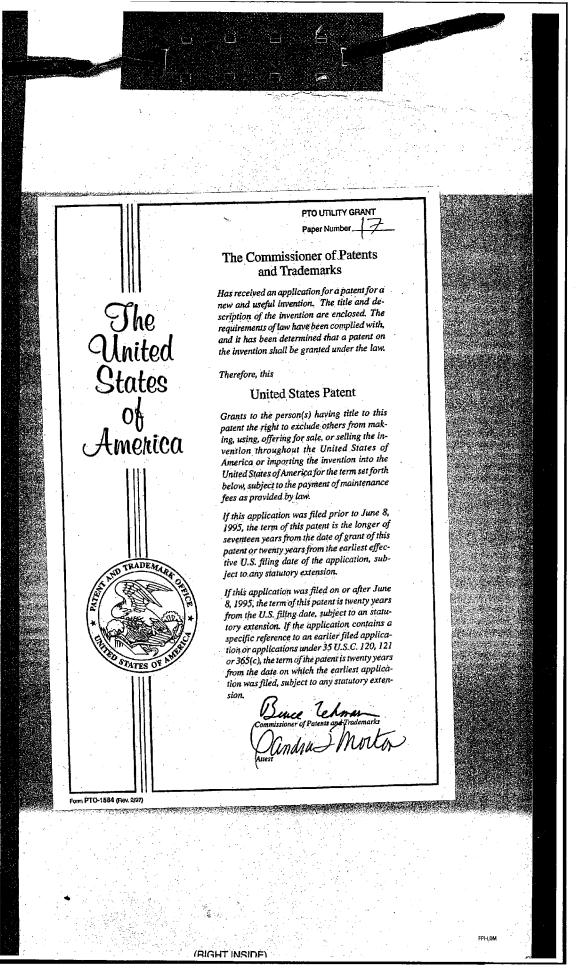


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> IPR2014-01030 / TSMC-1018 Page 170 of 178

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William E. Alford, Reg. No. 37,764; Farzad E. Amini, Reg. No. P42,261; Aloyslus 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. 42,936, Chain M. Ng, Reg. No. 505, Finite Triggy En. Ngy Ng. No. 42,936, Chainel 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. Selter, 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.

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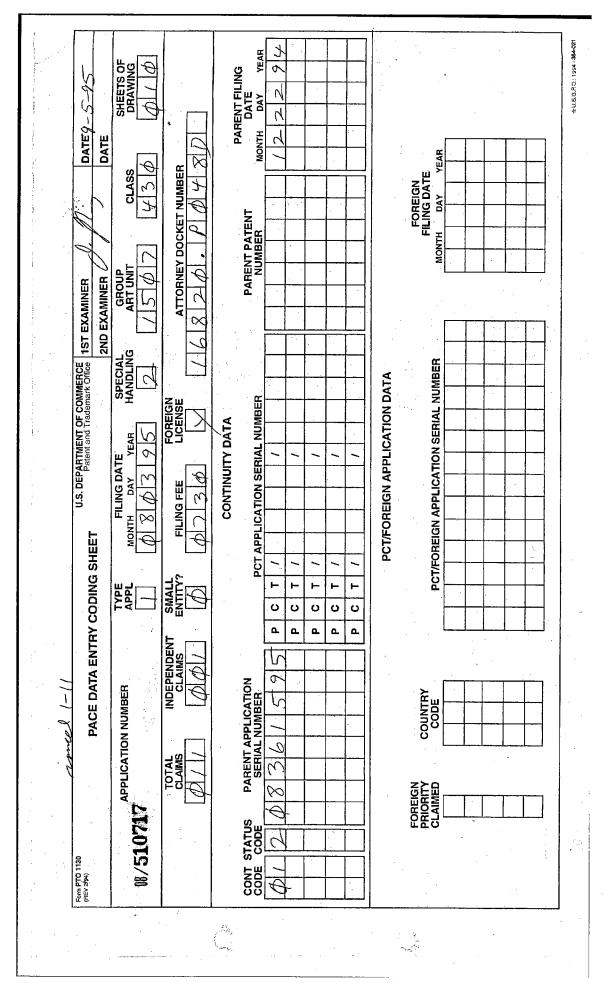
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ENT C		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDI- TIONAL FEE		RATE	ADDI- TIONAL FEE	
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		CL		S FILED -	PAR		umn 2)	_	SMALL	ENTITY	OR		THAN ENTITY	
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