Paper No. 20

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ERZHUANG LIU, CHARLES LIN
and YIH-SHUNG LIN

Appeal No. 1999-2596
Application No. 08/866,773

ON BRIEF

Before PAK, LIEBERMAN and JEFFREY T. SMITH, ***Administrative Patent Judges***.

JEFFREY T. SMITH, ***Administrative Patent Judge.***

DECISION ON APPEAL

Applicants appeal the decision of the Primary Examiner finally rejecting claims 4, 6 to 10, 12 to 16 and 19, all of the claims remaining in the application.[1] We have jurisdiction under 35 U.S.C. § 134.

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[1] The December 29, 1998 amendment to the claims filed subsequent to the final rejection has been entered by the Examiner. (Advisory Action, mailed January 12, 1999).

BACKGROUND

Appellants' invention relates to a method for forming composite barrier layers within integrated circuits. According to Appellants, the patterned barrier layer formed by the claimed method has limited susceptibility to delamination due to the consumption of titanium metal beneath the patterned barrier layer. Claim 4, which is representative of the claimed invention, appears below:

> 4. A method for forming a patterned barrier layer upon an electrode contact comprising:
> providing a silicon substrate layer having an electrode contact region formed within the silicon substrate layer;
> forming over the silicon substrate layer a blanket titanium layer, the blanket titanium layer contacting the electrode contact region of the silicon substrate layer;
> processing thermally the blanket titanium layer in a nitrogen containing atmosphere to form a titanium silicide layer in contact with the electrode contact region and a blanket titanium nitride layer formed thereover, where the blanket titanium layer is completely consumed in forming the titanium silicide layer and the blanket titanium nitride layer;
> forming upon the blanket titanium nitride layer a blanket barrier layer;
> forming over the blanket barrier layer a patterned photoresist layer formed of a material which is susceptible to stripping within a photoresist stripper composition comprising a hydroxyl/amine compound;
> etching, while employing the patterned photoresist layer as an etch mask layer, the blanket barrier layer to form a patterned barrier layer and the blanket titanium nitride layer to form a patterned titanium nitride layer; and
> stripping from the silicon substrate layer the patterned photoresist layer through use of the photoresist stripper composition comprising the hydroxyl/amine compound, where there is avoided delamination of the patterned barrier layer from the silicon substrate layer by completely consuming the blanket titanium layer when forming the titanium silicide layer and the blanket titanium nitride layer.

CITED PRIOR ART

As evidence of unpatentability, the Examiner relies on the following references:

Ajika et al. (Ajika)	5,049,975	Sept. 17, 1991
Nakamura et al. (Nakamura)	5,312,774	May 17, 1994
Yu et al. (Yu)	5,380,678	Jan. 10, 1995
Lee	5,381,807	Jan. 17, 1995

The Examiner rejected claims 4, 6 to 10, 12 to 16 and 19 under 35 U.S.C. § 103(a) as unpatentable over the combination of Ajika, Nakamura, Yu, Lee and the admitted prior art. (Specification page 4). (Answer p. 4).

According to the Examiner, Ajika teaches multilayered interconnections structures for a semiconductor device. The Examiner asserts Ajika fails to recite that the entire layer of titanium is consumed into titanium silicide and titanium nitride layers. (Answer, p. 4). To remedy the deficiency the Examiner relies upon Nakamura. The Examiner asserts Nakamura teaches a method of manufacturing a semiconductor device wherein titanium is deposited on a silicon substrate and converted to a TiN/Ti/TiSi or a TiN/TiS barrier layer. The Examiner concludes that the formation of a bi-layer or tri-layer barrier structure would have been obvious to a person of ordinary skill in the art. (Answer, p. 5).

Next the Examiner determines that the combination of Ajika and Nakamura fails to teach forming another barrier layer on top of the TiN layer and forming a conductor layer on top of another barrier layer. To remedy this deficiency the Examiner relies on Yu. According to the Examiner, Yu teaches forming two barrier layers that are covered by a metal conductor layer. The Examiner concludes that similar results could be obtained by a person of ordinary skill in the art. (Answer, pp. 5-6).

The Examiner then realizes that the combination of Ajika, Nakamura and Yu is deficient because there is no teaching of forming a patterned photoresist which is susceptible to stripping by a stripper composition comprising hydroxyl/amine compound. To remedy this deficiency the Examiner relies on the admitted prior art and the Lee reference. (Answer, p. 6).

Finally the Examiner concludes "[t]herefore, it would have been obvious for one skilled in the art at the time the invention was made to have modified Ajika et al. (5,049,975) in view of Nakamura et al. (5,312,774) further in view of Yu et al. (5,380,678) barrier process by incorporating a patterned photoresist which is susceptible to stripping by a stripper composition comprising hydroxyl/amine compound as evidenced by Applicant's admitted state of the art and Lee (5,381,807) because of the expectation of achieving similar success, i.e. a patterned barrier layer." (Answer, p. 6).

The burden of establishing a ***prima facie*** case of unpatentability rests upon the Examiner. ***See In re Oetiker,*** 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); ***In re Piasecki,*** 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). The Examiner has not provided motivation for forming a photoresist on the semiconductor device formed by Ajika. The Examiner also has not pointed out where the Ajika, Nakamura and Yu references disclose the formation of a photoresist on the barrier layer which is subjected to etching. The mere fact that the prior art could be modified would not have made the modification obvious unless the prior art suggests the desirability of the modification. ***In re Gordon,*** 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984); ***In re Laskowski,*** 871 F.2d 115, 117, 10 USPQ2d 1397, 1398 (Fed. Cir. 1989). The record indicates that the motivation relied upon by the Examiner for selection the specific order of steps comes from the Appellants' description of their invention in the specification rather than coming from the applied prior art and that, therefore, the Examiner used impermissible hindsight in rejecting the claims. ***See W.L. Gore & Associates v. Garlock, Inc.,*** 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983); ***In re Rothermel,*** 276 F.2d 393, 396, 125 USPQ 328, 331 (CCPA 1960). Accordingly, we reverse the Examiner's rejection under 35 U.S.C. § 103(a) over Ajika, Nakamura, Yu, Lee and the admitted prior art.

CONCLUSION

For the forgoing reasons, the Examiner's 35 U.S.C. § 103(a) rejection is reversed.

REVERSED

CHUNG K. PAK ***Administrative Patent Judge***	)	
PAUL LIEBERMAN ***Administrative Patent Judge***	)	**BOARD OF PATENT APPEALS AND INTERFERENCES**
JEFFREY T. SMITH ***Administrative Patent Judge***	)	

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