

The opinion in support of the decision being entered today was not written for publication in a law journal and is not binding precedent of the Board.

Paper No. 25

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SCOTT J. DEBOER
and HUSAM N. AL-SHAREEF

Appeal No. 2001-2540
Application No. 09/240,395

ON BRIEF

Before THOMAS, KRASS and BARRY, Administrative Patent Judges.
KRASS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 1-21.

The invention concerns the fabrication of semiconductor devices. More particularly, a transition metal boride film is used as a diffusion barrier in a gate stack disposed on a gate dielectric.

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Representative independent claim 1 is reproduced as follows:

1. An integrated circuit comprising:

a substrate;

a gate dielectric disposed over the substrate;

and

a gate stack disposed on the gate dielectric, the gate stack including;

a layer comprising silicon;

a transition metal boride layer disposed on the layer comprising silicon; and

a conductive layer disposed on the transition metal boride layer.

The examiner relies on the following references:

Lur et al. [Lur]	5,364,803	Nov. 15, 1994
Thomas	5,414,301	May 09, 1995

Claims 1-21 stand rejected under 35 U.S.C. 103 as unpatentable over Lur in view of Thomas.

Reference is made to the briefs and answer for the respective positions of appellants and the examiner.

OPINION

The examiner relies on Figure 2 of Lur for the teaching of an integrated circuit comprising a substrate 10, a gate dielectric 12 disposed over the substrate and a gate stack disposed on the gate dielectric 12, wherein the gate stack

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comprises a layer 14 comprising silicon, a transition layer 16 disposed on the layer containing silicon, and a conductive layer 18 disposed on the transition layer 16.

As the examiner recognized, Lur fails to disclose that the transition layer 16 is a "metal boride layer," as required by instant claims 1 and 14. The examiner turned to Thomas for a teaching, at column 5, lines 39-44, of the patent, of using either a metal nitride or a metal boride as a diffusion barrier to silicon from an underlying junction.

The examiner then concluded that it would have been obvious, within the meaning of 35 U.S.C. 103, to incorporate the metal boride barrier layer of Thomas into the gate stack of Lur in order to achieve "a highly stable gate stack" since the artisan would have recognized "that the gate stack itself is simply a conductive structure often used to interconnect other elements on the integrated circuit" [answer-pages 4-5].

Appellants argue that neither Lur nor Thomas suggests the use of a transition metal boride layer in a gate stack; that Thomas teaches away from the claimed invention in that Thomas avoids the formation of a barrier layer in a gate stack and that this is not a mere oversight but, rather, explicitly contemplated by Thomas by employing the barrier layer, e.g., 227 in direct

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contact with the dielectric layer, e.g., 224. Thus, according to appellants, applying Thomas to Lur, one would obtain a gate stack structure having a gate oxide layer, a transition boride layer directly over a portion of, and in contact with, the gate oxide layer, a polysilicon gate, a diffusion barrier layer over the polysilicon gate, and a conductor over the diffusion barrier layer, which is not the instant claimed subject matter comprising a transition metal boride layer provided in a gate stack between a layer comprising silicon and a conductive layer.

Therefore, conclude appellants, if one were to apply the teachings of Lur and Thomas in combination, it would lead to either no protective layer over the Lur gate stack or a protective barrier layer between the gate oxide and a polysilicon layer, neither of which is the claimed invention.

Further, appellants argue that since Thomas teaches that the protective barrier layer can be etched by a fluorine plasma, at column 7, lines 43-45, this would teach away from using such a barrier in Lur since Lur seeks to prevent fluorine atoms from reaching the gate oxide. Appellants state that "A material which is etchable by fluorine would not provide a good barrier to fluorine" [principal brief-page vii].

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Our review of the instant case finds that the examiner has established a prima facie case of obviousness since Lur teaches a gate stack structure essentially as recited in instant claim 1 but for the claimed metal boride layer; Lur teaching, instead, that a metal nitride layer and a metal boride layer were known to be used as a diffusion barrier layer. The examiner then, again quite reasonably, in our view, concludes that it would have been obvious to use a transition metal boride layer as the diffusion barrier in Lur, based on the teaching of Thomas.

The burden then passed to appellants to overcome the examiner's prima facie case by objective evidence and/or convincing argument.

We have reviewed appellants' arguments and find that such arguments are, indeed, sufficient to overcome the examiner's prima facie case of obviousness and, so, we will not sustain the rejection of claims 1-21 under 35 U.S.C. 103.

Although Thomas does not teach the use of a transition metal boride layer as a barrier layer within a gate stack, its teaching of both metal nitrides and borides as diffusion barriers would have led the artisan to use a metal boride as an equally obvious substitute for the titanium nitride employed by Lur as the diffusion barrier layer.

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However, as pointed out by appellants, the disclosed function of the diffusion barrier layer 16 in Lur is "to minimize the diffusion of fluorine atoms from the tungsten silicide to the gate oxide layer" [column 2, lines 50-51]. Yet, Thomas specifically discloses, at column 7, lines 42-45, that the "barrier metal layer is then dry etched with a fluorine or chloride based plasma which selectively attacks the barrier layer material."

If Lur seeks to minimize the diffusion of fluorine atoms, then it seems reasonable to us that the artisan would not employ a material in Lur that is taught to be etchable with a fluorine based plasma, i.e., a material that is to act as a barrier for a particular thing should not, reasonably, be etchable by that thing since etchability implies a poor barrier. Now, it may be that the fluorine etch in an uncontrolled environment will etch entirely through the "barrier" layer in which case it appears clear that this layer is not a barrier to fluorine. But Lur wants to minimize the diffusion of fluorine. Accordingly, it

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would appear that the skilled artisan would have been led away from using the boride layer of Thomas as a barrier layer in Lur.

Moreover, it is clear from Thomas that the boride layer therein is being used as a barrier to stop silicon diffusion from below (e.g., column 12, lines 23-25). Accordingly, we find no suggestion to the artisan to somehow employ such a layer in Lur where the interest is in minimizing the diffusion of fluorine atoms from the tungsten silicide layer down to the gate oxide layer.

Since, in our view, Thomas would lead the artisan away from using a transition metal boride barrier layer in Lur, we find appellants' argument sufficient to overcome the examiner's prima facie case and we will not sustain the rejection of claims 1-21 under 35 U.S.C. 103.

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The examiner's decision is reversed.

REVERSED

James D. Thomas)	
Administrative Patent Judge)	
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Errol A. Krass)	BOARD OF PATENT
Administrative Patent Judge)	APPEALS AND
)	INTERFERENCES
)	
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)	
Lance Leonard Barry)	
Administrative Patent Judge)	

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