UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SALMAN AKRAM and Y. JEFF HU

Appeal 2007-3477
Application 10/173,936
Technology Center 2800

Decided: March 10, 2008

Before KENNETH W. HAIRSTON, JOSEPH F. RUGGIERO,
and MAHSHID D. SAADAT, *Administrative Patent Judges*.

SAADAT, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF CASE

Appellants appeal under 35 U.S.C. § 134(a) from a Final Rejection of claims 1-5, which are all of the claims pending in this application. We have jurisdiction under 35 U.S.C. § 6(b).

Appellants' invention relates to a method of forming silicide interfaces wherein a porous dielectric layer is disposed between a silicon-containing substrate and a silicidable material (Spec. 5). During the anneal process for forming the silicide, silicide material may also form in imperfections or voids within the porous dielectric, which can cause shorting and current leakage (*id.*). According to Appellants, application of a barrier layer between the dielectric material and the silicidable material prevents formation of silicide material through the voids and passages in the dielectric layer (*id.*).

Claim 1, which is representative of the claims on appeal, reads as follows:

> 1. A semiconductor device structure, comprising:
>
> a substrate comprising a semiconductor material and including at least one active-device region;
>
> a layer comprising dielectric material located over the substrate;
>
> at least one contact opening formed through the layer, the at least one contact opening exposing at least a portion of the at least one active device region;
>
> a metal silicide within the at least one contact opening and in contact with the portion of the at least one active device region, voids and imperfections continuous with an upper major surface of the layer being substantially free of metal silicide and silicidable material.

The prior art applied in rejecting the claims on appeal is:

Havemann	US 5,661,344	Aug. 26, 1997
Kuo	US 6,169,025 B1	Jan. 2, 2001 (filed Jun. 10, 1998)

The Examiner rejected claims 1-5 under 35 U.S.C. § 103(a) based upon the teachings of Kuo and Havemann.

We affirm.

ISSUE

Under 35 U.S.C § 103(a), with respect to the appealed claims 1-5, would the ordinarily skilled artisan have found it obvious to modify Kuo with Havemann to render the claimed invention unpatentable?[1]

PRINCIPLES OF LAW

To reach a conclusion of obviousness under section 103, the Examiner bears the burden of producing factual basis supported by teaching in a prior art reference or shown to be common knowledge of unquestionable demonstration. Our reviewing court requires this evidence in order to establish a prima facie case. *In re Piasecki*, 745 F.2d 1468, 1471-72 (Fed. Cir. 1984).

Furthermore, the test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. *See In re Kahn*, 441 F.3d 977, 987-988 (Fed. Cir. 2006), *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991) and *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

"Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such

[1] The Examiner has withdrawn the rejection of claims 1-5 under the first and the second paragraphs of 35 U.S.C. § 112 (Ans. 2-3), which leaves the 35 U.S.C. § 103(a) rejection of the claims as the only issue before this panel.

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.'" *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

"The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Leapfrog Enter., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1161 (Fed. Cir. 2007) (quoting *KSR*, 127 S. Ct. at 1739-40). "One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims." *KSR*, 127 S. Ct. at 1742.

ANALYSIS

Appellants do not dispute the teachings of Kuo with respect to the claimed elements such as the substrate, dielectric layer, contact opening, and the metal silicide within the contact opening. However, Appellants' contentions focus on whether the combination of Kuo and Havemann teaches the claim limitation of voids and imperfections in a layer that comprises dielectric material are "'substantially free of metal silicide and silicidable material'" and whether such combination would have been obvious to one of ordinary skill in the art (App. Br. 10-11).

Appellants specifically contend that Havemann's insulating cap layer is formed of material that inherently includes voids and imperfections that would likely allow for formation of metal silicide within voids of the underlying porous layer (App. Br. 11). The Examiner responds (Ans. 6-7) that Havemann identifies the problem of formation of filaments of

conductive material in the porous dielectric layer (col. 2, ll. 55-64) and solves the problem by using a cap layer 24 of silicon oxide or silicon nitride between the porous dielectric layer 22 and the metallic conductor 38 (col. 5, ll. 59- 63).

We agree with the Examiner's line of reasoning and find that Havemann clearly solves the problem of filament formation in the porous dielectric layer by using a cap layer. In fact, contrary to Appellants' argument (Reply Br. 4), whether the cap layer is porous or substantially solid is not relevant to the claimed features of claim 1 which merely recite the condition and the characteristics of the dielectric layer without reciting a barrier or cap layer. As such, while Havemann's cap layer may not be inherently void free, its effect on the underlying porous dielectric layer is explicitly taught to be preventing the conductive material from filling the voids and imperfections in the dielectric layer and forming filaments (col. 2, ll. 55-64), independently of how porous the dielectric is.

Additionally, Appellants contend that the combination of Kuo and Havemann would not have been obvious to one of ordinary skill in the art since the insulating cap of Havemann is formed of the same type of materials used for the dielectric layer (Br. 11). Appellants further argue that while both references teach processes in which a silicide layer is formed, neither one discusses preventing the introduction of a silicidable material or silicide into the voids or imperfections that are continuous with a surface of the respective dielectric layer and insulating cap thereof (*id.*).

In response, the Examiner points out that the cap layer 24 prevents the metal from seeping or migrating into the voids and imperfections of the porous dielectric layer 22 (Ans. 7-8). The Examiner concludes that the

protected dielectric layer 22 meets the claimed limitation of "'voids and imperfections continuous with an upper major surface of the layer being substantially free of metal silicide and silicidable material'" (Ans. 8).

Again, we disagree with Appellants that the type of the material used in the cap layer of Havemann or whether it is another dielectric precludes its combination with Kou for protecting the dielectric layer from filament formation. As discussed above, Havemann suggests protecting the dielectric layer from the conducting layer by forming a cap layer in between which prevents formation of filaments in the porous dielectric layer (col. 2, ll. 55-64). In other words, we disagree with Appellants' assertion (App. Br. 11) implying that the voids and imperfections that are continuous with a surface of *both the dielectric layer and the cap layer* are to be free of metal silicide or silicidable material. Therefore, using silicon oxide or silicon nitride as the cap layer 24 (col. 5, ll. 59-63), as long as the filament formation at least in the dielectric layer 22 is prevented, satisfies the claimed requirement of voids and imperfections continuous with the upper surface of the dielectric layer being substantially free of metal silicide or silicidable materials.

For all of the previously discussed reasons, we simply find no error in the Examiner's position that using a cap layer to prevent formation of filaments in the underlying dielectric, as taught by Havemann, would be recognized by the skilled artisan as an obvious enhancement to the silicide formation of Kou. According to *Leapfrog*, when combination of familiar elements according to methods known to the skilled artisan, such as preventing the conducting material from forming filaments in the voids in dielectric layer, achieves a predictable result, it is likely to be obvious.

CONCLUSION OF LAW

Because Appellants have failed to point to any error in the Examiner's position, we sustain the 35 U.S.C. § 103 rejection with respect to claim 1 and also with respect to claims 2-5, which are not argued separately (App. Br. 12).

DECISION

The decision of the Examiner rejecting claims 1-5 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. 1.136(a)(1)(iv).

AFFIRMED

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