UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SHIGERU FUJITA

Appeal 2008-3246
Application 10/390,768
Technology Center 2800

Decided: December 12, 2008

Before CHARLES F. WARREN, CATHERINE Q. TIMM, and JEFFREY T. SMITH, *Administrative Patent Judges*.

SMITH, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the Primary Examiner's rejection of claims 6-9, 11, 12, 17-19, 21, and 22. We have jurisdiction pursuant to 35 U.S.C. § 6. [1]

[1] In rendering this decision we have considered the Appellant's arguments presented in the Appeal Brief dated February 28, 2007 and the Reply Brief dated September 26, 2007.

Appellant's invention is directed to a method of manufacturing a semiconductor device suitable for application to a semiconductor device that includes a MIS (metal-insulator-semiconductor) transistor using a p-type impurity-contained silicon layer as its gate electrode, for example. (Spec. 1). Claim 6 is representative of the invention and is reproduced below:

> 6. A method of manufacturing a semiconductor device comprising the steps of:
>
> forming a high-dielectric-constant film on a semiconductor substrate;
>
> forming a nitride layer over the top surface of the high-dielectric-constant film by introducing nitrogen into the top surface portion of the high-dielectric-constant film by using radical nitrogen,
>
> wherein the high-dielectric constant film is comprised of enhanced dielectric materials including at least a $Al_2O_3/HfO_2/ Al_2O_3$ multilayer structure,
>
> wherein said nitride layer has a thickness less than 0.5 nm, and wherein forming the nitride layer includes introducing the substrate with the high-dielectric constant film into a nitriding apparatus, evacuating a processing chamber of the nitriding apparatus, introducing nitrogen gas into the processing chamber at approximately 300-400 sccm, and applying RF power to the processing chamber at a rating of 200 to 1000 W.

ISSUES ON APPEAL

Claims 6-9, 11, 12, 17-19, 21, and 22 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Callegari, U.S. Patent No. 6,664,186 B1, issued December 16, 2003, in view of Pomarede, U.S. Patent No. 6,613,695 B2, issued September 2, 2003, Hu, U.S. Patent Application Publication No.

2003/0080389, dated May 1, 2003, and Bojarczuk U.S. Patent Application Publication No. 2002/0190302 to dated December 19, 2002.

The Examiner contends that Callegari discloses a semiconductor device that comprises the same structure as the device produced by Appellant's claimed method. However, the Examiner contends that Callegari does not describe the claimed processing conditions. Specifically the Examiner contends that Callegari does not disclose the manufacturing method wherein nitride layer has a thickness about 0.2 nm -1.5nm, wherein forming the nitride layer includes introducing the substrate with the high dielectric constant film into the nitriding apparatus, evacuating a processing chamber of the nitriding apparatus, introducing nitrogen gas into the processing chamber at approximately 300-400 sccm, and applying RF power to the processing chamber at a rating of 200 to 100 W. (Ans. 4). The Examiner contends that Pomarede, Hu, and Bojarczuk are evidence that these processing conditions are known to have been conventional. (Ans. 4-8).

Appellant contends that the Examiner has failed to explain why it would have been obvious to modify the structure of Callegari with the structures described by Pomarede and Hu.[2,3] (App. Br. 6-12; Reply Br. 2-9).

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[2] Appellant has grouped the arguments for claims 6-9, 11, 12, 17-19, 21, and 22 together. Consequently, the appealed claims stand or fall with independent claim 6. Our analysis will be limited to claim 6.

[3] The Examiner relied upon the Bojarczuk reference for elements that do not appear in claim 6. Consequently, our discussion of the issues on appeal will not include a discussion of the Bojarczuk reference.

The issue presented is: did Appellant identify reversible error in the Examiner's rejection of claim 6 under § 103? We answer this question in the negative. The issue turns on whether it would have been obvious to a person of ordinary skill in the art to utilize conventional techniques for forming a semiconductor substrate described in Callegari.

We have thoroughly reviewed each of Appellant's arguments for patentability. However, we are in complete agreement with the Examiner that the claimed subject matter is not patentable within the meaning of § 103 in view of the applied prior art. Accordingly, we will sustain the Examiner's rejection.

OPINION

The Examiner found and Appellant does not dispute the following facts (FF) in this appeal:

(1) Callegari describes a semiconductor device comprising a nitride layer over the top surface of an $Al_2O_3/HfO_2/Al_2O_3$ high-dielectric-constant film on a semiconductor substrate. (Ans. 3-4).

(2) Pomarede discloses process parameters, for manufacturing a semiconductor, such as temperature, pressure, plasma power, process duration and reaction in concentrations can be adjusted dependent upon the surface conditioning. (Ans. 5; Pomarede, col. 13, l. 59 to col. 14, l. 3).

(3) Pomarede describe a semiconductor manufacturing method wherein the substrate with the high dielectric constant film is introduced into the nitriding apparatus, evacuating a processing chamber of the nitriding apparatus, introducing nitrogen gas into the processing chamber nitride layer has a thickness about 0.2 nm - 0.5nm. (Ans. 4-5; Pomarede col. 14, ll. 4-17).

(4) Hu describe a semiconductor manufacturing method wherein the RF power lines in the processing chamber had a rating of 200W to 2000W and a nitrogen radical flow rate ranging from 1 to 100 sccm. (Ans. 5).

(5) The Examiner determined that a person of ordinary skill in the art would have arrived at the claimed nitrogen gas flow rate of approximately 300-400 sccm through routine experimentation. (Ans. 6).

Under 35 U.S.C. § 103, the factual inquiry into obviousness requires a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) secondary considerations, if any. *See Graham v. John Deere Co.,* 383 U.S. 1, 17-18 (1966). "[A]nalysis [of whether the subject matter of a claim is obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR Int'l Co. v. Teleflex Inc.,* 127 S. Ct. 1727, 1740-41 (2007). "[I]f a technique has been used to improve

one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.; see also DyStar Textilfarben GmBH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1361 (Fed. Cir. 2006) ("The motivation need not be found in the references sought to be combined, but may be found in any number of sources, including common knowledge, the prior art as a whole, or the nature of the problem itself.").

It is an axiomatic that where patentability is predicated upon a change in a condition of a prior art element, such as a change in size, configuration or concentration, the burden is on the applicant to establish which objective evidence that the change is critical, i.e., it leads to a new, unexpected result. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990); *In re Aller*, 220 F.2d 454, 456 (CCPA 1955). In the present case, Appellant has not established on this record that inlet orifices within the scope of the appealed claims achieve a new, unexpected result regarding uniformity of a layer deposited on a wafer.

Applying the preceding legal principles to the Factual Findings (FF) in the record of this appeal, we determine that the Examiner has established a prima facie case of obviousness, which prima facie case has not been adequately rebutted by Appellant's arguments. As shown by FF (1) above, Callegari describes a semiconductor device comprising a nitride layer over the top surface of an $Al_2O_3/HfO_2/Al_2O_3$ high-dielectric-constant film on a semiconductor substrate. As shown by FF (2-5) the processing conditions of the claimed invention are conventional. A person of ordinary skill in the art

would have recognized that process parameters such as temperature, pressure, plasma power, process duration, and reaction in concentrations could be adjusted dependent upon the surface conditioning. (FF (2)). The Examiner properly concluded that it would have been obvious to a person of ordinary skill in the art to utilize conventional techniques for forming a semiconductor substrate described in Callegari. Appellant has not indicated that the claimed process parameters when so combined produce unexpected results or that these conditions were not known to have been conventional to a person of ordinary skill in the art. (S*ee* Briefs generally).

Regarding the Hu reference Appellant argues the Examiner has failed to explain why the method of Hu would have been suitable for the problem identified in Callegari. (App. Br. 10). Appellant's argument is not persuasive. Hu, like Callegari, is directed to the manufacture of semiconductor devices. Thus, a person of ordinary skill in the art would have reasonably expected that known conventional techniques such as those described in Hu would have been suitable for forming the semiconductor device of Callegari.

The Examiner contended that based upon the teachings of Pomarede and Hu (FF (2-5)) it would have been obvious to a person of ordinary skill in the art, depended upon surfacing conditions, to optimize the RF power and the flow rate of the nitrogen into the semiconductor apparatus to obtain the values of the claimed invention. (Ans. 5-6). Appellant has not argued that the RF power and the flow rate of the nitrogen are not result effective variables that depend upon surfacing conditions. (S*ee* Briefs generally).

Consequently, Appellant has not adequately rebutted the Examiner's prima facie case of unpatentability.

Appellant's arguments regarding replacing the structures of Callegari with the structures described by Pomarede and Hu are not persuasive. The claimed invention is directed to a method of manufacturing a semiconductor device. Appellant has not asserted that a person of ordinary skill in the art would not have recognized that the processing conditions described in Pomarede and Hu would not have been suitable for forming the structures of Callegari. Appellant also has not directed us to evidence of unexpected results, that are achieved by utilizing the combination of processing conditions, to rebut the Examiner's prima facie case.

For the foregoing reasons and those stated in the Answer, we affirm the rejection presented in this appeal.

ORDER

The rejection of claims 6-9, 11-12, 17-19, 21, and 22 under 35 U.S.C. § 103(a) 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

PL Initial:
sld

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