

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* MANOJ MEHROTRA,  
WAYNE A. BATHER, REJI K. KOSHY,  
AMITABH JAIN, MARK S. RODDER,  
RAJESH B. KHAMANKAR,  
PAUL A. TINER, RICK L. WISE,  
and DARIN K. WEDEL

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Appeal 2008-3244  
Application 10/146,457  
Technology Center 2800

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Decided: August 5, 2008

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Before TERRY J. OWENS, CATHERINE Q. TIMM, and  
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1-4, 7, 8, 11, 13, 14, 16, and 17. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

## I. BACKGROUND

The invention relates to a method for depositing a dielectric spacer layer within a semiconductor device. (Spec. 1, ll. 7-11). The method includes depositing the spacer layer by low pressure chemical vapor deposition (hereinafter “LPCVD”) using bistertiarybutylaminosilane (hereinafter “BTBAS”) or hexachlorodisilane (hereinafter “HCD”) as a source gas, for example, such that an adequate deposition rate can be maintained at a temperature of 650°C or less. (Spec. 10, ll. 9-11; 10, l. 30 to 11, l. 5). Forming a spacer layer at a relatively low temperature minimizes dopant loss and deactivation of a semiconductor gate. (Spec. 10, ll. 20-30).

Claim 1 is illustrative of the subject matter on appeal:

1. A method of forming a semiconductor device, comprising:
  - doping at least one region of an at least partially formed semiconductor device; and
  - depositing at least one dielectric spacer layer comprising at least seven (7) percent hydrogen and no more than fifty-one (51) percent hydrogen outwardly from the at least one region of the at least partially formed semiconductor device;
  - wherein the at least one deposited spacer layer is formed in an environment that substantially minimizes dopant loss and deactivation in the at least one region of the at least partially formed semiconductor device.

Appellants request review of the rejections maintained by the Examiner, namely, the rejection of claims 1-4, 7, 8, 11, and 13 under 35 U.S.C. § 112, first paragraph, and the rejection of claims 1-4, 7, 8, 11, 13, 14, 16, and 17 under 35 U.S.C. § 103(a) as obvious over U.S. Patent Application Publication Number US 2002/0127763 A1, issued on September 12, 2002 to Arafa, et al. (hereinafter “Arafa”).

## II. DISCUSSION

### *Rejection under 35 U.S.C. § 112, first paragraph*

Claims 1-4, 7, 8, 11, and 13 are rejected under 35 U.S.C. § 112, first paragraph for failing to comply with the written description requirement. (Ans. 3). The Examiner notes that, among other limitations, claim 1 calls for “no more than fifty-one (51) percent of hydrogen,” which was not described in the Specification so as to reasonably convey to one of ordinary skill in the art that the inventors had possession of the claimed invention. (Ans. 3).

Appellants admit that the rejection is proper in that, due to a typographical error, claim 1 should have recited “no more than fifty-one (51) percent nitrogen.” (Reply Br. 3). Appellants request that the Board remand the case to the Examiner to correct claim 1 by Examiner’s amendment. (Reply Br. 3).

Based on Appellants’ admission, we summarily sustain the Examiner’s rejection. With regard to the remaining rejection under 35 U.S.C. § 103(a), both the Examiner and Appellants present their contentions as if the claim were already corrected to read “nitrogen.” Therefore, we proceed to review the § 103(a) rejection as the issue is ripe for our review and decline to remand this case to the Examiner for correction.

### *Rejection under 35 U.S.C. § 103(a)*

Claims 1-4, 7, 8, 11, 13, 14, 16, and 17 are rejected under 35 U.S.C. § 103 as being obvious over the teachings of Arafa. Appellants do not present separate arguments with respect to any of the claims in the Appeal Brief.<sup>1</sup> (See App. Br.). Accordingly, we decide the appeal on the basis of

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<sup>1</sup> Although Appellants provide separate comments with respect to claims 8 and 17, these comments are provided only in the Reply Brief. 37 C.F.R.

representative claim 1. 37 C.F.R. § 41.37(c)(1)(vii) (“When multiple claims subject to the same ground of rejection are argued as a group by appellant, the Board may select a single claim from the group of claims that are argued together to decide the appeal with respect to the group of claims as to the ground of rejection on the basis of the selected claim alone.”).

Appellants argue that Arafa does not disclose a dielectric spacer layer having the claimed percentages of hydrogen and nitrogen. (App. Br. 3-4; Reply Br. 4). According to Appellants, the concentration of BTBAS as a source gas does not necessarily translate to the concentration in a spacer layer because “BTBAS can be used in an infinite number of ways to form dielectric layers with largely varying compositions.” (App. Br. 3-4). Appellants also argue that Arafa teaches the use of a combination of source gases including BTBAS and oxygen or ammonia, rather than BTBAS as a source gas alone. (Reply Br. 4). Additionally, “the concentrations of oxygen and ammonia in the ‘deposited’ spacer layer of *Arafa et al.* are essential to the disclosure and their removal will destroy the intended teaching and function thereof.” (Reply Br. 5). Appellants also argue that “the deposited spacer is necessarily distinct from the claimed spacer due to the added sources of oxygen and ammonia required for depositing the *Arafa et al.* spacer layers.” (Reply Br. 5). The Examiner responds that Arafa teaches a similar process where a spacer layer is deposited in an environment including BTBAS at a temperature of 500-650°C. (Ans. 7-8). The Examiner also notes that the chemical formula for BTBAS is

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§ 41.37(c)(1)(vii) requires that Appellants group and separately argue claims in the Appeal Brief.

H<sub>2</sub>Si(NHC<sub>4</sub>H<sub>9</sub>)<sub>2</sub>, which has 12% hydrogen and 16% nitrogen meeting the claimed concentrations. (Ans. 8).

The issue on appeal arising from the contentions of Appellants and the Examiner is: have Appellants shown that the Examiner reversibly erred in determining that it would have been obvious to one of ordinary skill in the art to provide a spacer layer having hydrogen and nitrogen concentrations within the claimed ranges?

The evidence of record supports the following Findings of Facts (FF):

1. Appellants' Specification recites that

[f]irst spacer layer 20 may comprise any dielectric material, such as, for example, nitride, silicon nitride, oxide, oxi-nitride, or silicon oxide. In some embodiments, first spacer layer 20 may comprise a dielectric material comprising at least seven (7) percent hydrogen and no more than fifty-one (51) percent nitrogen...The hydrogen concentration within spacer layer 20 denotes that spacer layer 20 was formed in an environment that comprises hydrogen. The higher the concentration of hydrogen in spacer layer 20 the greater the hydrogen concentration in the environment.

(Spec. 9, ll. 1-14).

2. Appellants' Specification states that “[u]sing nitride as the dielectric material of second spacer layer 26 is particularly advantageous in controlling the etching process.” (Spec. 13, ll. 25-28).

3. Appellants' Specification recites that “The environment may comprise any material capable of maintaining a sufficient deposition rate of the dielectric material, for example, bistertiarybutylaminosilane (BTBAS) or hexachlorodisilane (HCD). In some embodiments, formation of first spacer layer occurs in a temperature of 650°C or less.” (Spec. 10, l. 30 to 11, l. 2).

4. Appellants' Specification states that the graphs of Figure 2 demonstrate "that deposition rates of greater than four (4) angstroms per minute can be achieved in both the BTBAS and HCD environments, where the temperature is approximately 550°C or more" and "[d]epositing the nitride spacer layer in the 700°C DCS environment, typically results in deactivation of the dopants implanted in the semiconductor gate and drain extension areas of the semiconductor device." (Spec. 16, ll. 8-18).

5. Appellants' Specification only discusses deposition by low pressure chemical vapor deposition (LPCVD). (Spec. 10, ll. 9-13).

6. Arafa teaches that it is "conventional" to deposit a layer of "silicon nitride from a low temperature decomposition of bis(tertiarybutylamino) silane" over a silicon oxide layer. (Arafa 2, ¶ 30).

7. Arafa teaches "forming a sidewall spacer by in-situ deposition of a tri-layer of silicon oxide/silicon nitride/silicon oxide using bis-(tertiarybutylamino) silane (BTBAS) as one of the source gases for the formation of all three layers." (Arafa 2, ¶ 32).

8. Arafa teaches that the layers of the sidewall spacer are produced at temperatures between 550 and 600°C. (Arafa 3, ¶¶ 42, 43 and 45).

9. Arafa explains that the sidewall spacer is formed by "in-situ chemical depositions by the thermal decomposition of bis-(tertiarybutylamino) silane with oxygen or ammonia depending upon whether an oxide or a nitride is to be formed." (Arafa 4, ¶ 48).

10. Arafa teaches that the silicon oxide layers of the sidewall spacer are also formed in an environment including a gas flow of 0.2 liters/min oxygen and a gas flow of 0.55 liters/min of BTBAS. (Arafa 3, ¶¶ 42 and 45).

11. Arafa teaches that the silicon nitride layer of the sidewall spacer is formed in an environment including a gas flow of 0.4 liters/min ammonia and a gas flow of 0.55 liters/min of BTBAS. (Arafa 3, ¶¶ 43).

Applying legal principles to the Factual Findings in the record of this appeal, we determine that the Examiner has established a *prima facie* case of obviousness.

Arafa teaches the same method of depositing a layer of silicon nitride as does Appellants' Specification, i.e. chemical vapor deposition using BTBAS as a source gas at a temperature between 550°C and 650°C. (FF 1-9). We find it reasonable to believe that a layer of silicon nitride produced by LPCVD using BTBAS and ammonia source gases at a temperature of less than 600°C as taught by Arafa would inherently result in a spacer layer having hydrogen and nitrogen concentrations as claimed<sup>2</sup>.

Appellants' Specification provides no examples or specific process descriptions different from that taught by Arafa to demonstrate to one of

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<sup>2</sup> See, e.g., Laxman et al., "Materials: A low-temperature solution for silicon nitride deposition," *Solid State Technology*, Vol. 43, Issue 4, available at <[http://www.solid-state.com/display\\_article/67035/5/none/none/Feat/Materials:-A-low-temperature-solution-for-silicon-nitride-depositio](http://www.solid-state.com/display_article/67035/5/none/none/Feat/Materials:-A-low-temperature-solution-for-silicon-nitride-depositio)> (April 2000) ("The hydrogen concentration in the films was <10 atomic percent as measured by hydrogen forward scattering."); Gumper et al., "Characterization of Low-Temperature Silicon Nitride LPCVD from Bis(tertiary-butylamino)silane and Ammonia," *Journal of the Electrochemical Society*, Vol. 151, Issue 5, pp. G353-G359 (2004) available at <<http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JESOAN00015100000500G353000001&idtype=cvips&gifs=yes>> ("Hydrogen concentrations of 15 atom% are detected in both high-flow and low-flow BTBAS silicon nitride samples.... The elevated hydrogen levels of BTBAS-derived silicon nitride are primarily due to less efficient by-product desorption/elimination at lower deposition temperature."))

ordinary skill in the art how to achieve a layer containing “at least seven (7) percent hydrogen and no more than fifty-one (51) percent nitrogen.” (*See Spec.*) Although Appellants argue that the Specification teaches the use of BTBAS alone, we find nothing in the claim language or Specification to suggest that additional source gases are necessarily excluded from the depositing step of the claimed method. To the contrary, the Specification indicates that the spacer layer having the concentrations of hydrogen and nitrogen claimed may be a silicon oxide layer, as is taught by Arafa. (FF 1, 2, 4, 7, and 9). Since BTBAS contains no oxygen, an additional source gas would be required to provide the oxygen atoms to form a silicon oxide layer. Likewise, we find nothing in the Specification to indicate that using BTBAS alone is responsible for achieving the claimed concentrations of hydrogen and nitrogen.

In a case such as this, where the Patent Office has reason to believe that a limitation “in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on.” *In re Best*, 562 F.2d 1252, 1254-1255 (CCPA 1977); *see also In re Skoner*, 517 F.2d 947, 950 (CCPA 1975)(“Appellants have chosen to describe their invention in terms of certain physical characteristics... Merely choosing to describe their invention in this manner does not render patentable their method...”).

Arafa teaches providing BTBAS, oxygen, and an ammonia source gas to provide a silicon nitride or silicon oxide spacer layer (FF 7 and 9). Arafa also teaches example gas flow rates for BTBAS, oxygen and ammonia. (FF 10 and 11). Under the circumstances, the burden shifts to Appellants to

demonstrate that the claimed concentration ranges of hydrogen and nitrogen would not have been achieved using the process of forming the silicon oxide and silicon nitride layers taught by Arafa. *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990); *In re Best*, 562 F.2d 1252, 1255, (CCPA 1977).

Appellants have provided no evidence, other than representative argument, that the presence of an oxygen and/or ammonia source gas in the concentrations disclosed by Arafa would create a spacer layer having a hydrogen and nitrogen concentration that would fall outside of the ranges claimed.

Based on the totality of record, including due consideration of the Appellants' arguments, we determine that the Examiner did not reversibly err in concluding that it would have been obvious to one of ordinary skill in the art to provide a spacer layer having hydrogen and nitrogen concentrations within the claimed ranges.

### III. CONCLUSION

We sustain the Examiner's rejections under 35 U.S.C. § 112, first paragraph, and 35 U.S.C. § 103(a).

### IV. DECISION

The decision of the Examiner is affirmed.

### V. TIME PERIOD FOR RESPONSE

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

AFFIRMED

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