THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 21

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ISRAEL BEINGLASS and MAHALINGAM VENKATESAN

Appeal No. 95-3438
Application No. 08/033,656[1]

HEARD: February 8, 1999

Before JOHN D. SMITH, WARREN and LIEBERMAN, Administrative Patent Judges.

JOHN D. SMITH, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal pursuant to 35 U.S.C. § 134 from the final rejection of claims 1 through 7.

The subject matter on appeal is directed to a method of depositing a stoichiometric silicon nitride film of uniform thickness on a single substrate (e.g., a single large diameter

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[1] Application for patent filed March 16, 1993.

silicon semiconductor wafer) by reacting ammonia with a silane compound in a low pressure chemical vapor deposition (LPCVD) chamber wherein, inter alia, the pressure is adjusted to from about 5 to 100 Torr. Claim 1 is representative and is reproduced below:

1. A method of depositing films of silicon nitride onto a single substrate in a low pressure chemical vapor deposition chamber comprising

a) supporting a single substrate in said chamber;

b) adjusting the pressure to from about 5 to about 100 Torr and heating the substrate to a temperature of from about 650 to about 850EC; and

c) passing a precursor gas mixture comprising a silane gas and ammonia into said chamber,

thereby depositing a film of stoichiometric silicon nitride of uniform thickness onto said substrate.

As evidence of obviousness, the examiner relies on the following references:

Chiang 4,395,438 July 26, 1983

Morosanu, “Thin Films by Chemical Vapour Deposition ” Thin Films Science and Technology, p. 48 (1990)

Schuegraf, “Handbook of Thin-Film Deposition Processes and Techniques” Noyes Publication, pp. 81 and 86 (1988)

As evidence of nonobviousness, appellants rely on the

following reference:

Sakai et al. (Sakai)	4,699,825	Oct. 13, 1987

The appealed claims stand rejected for obviousness (35 U.S.C. § 103) over Chiang in view of Morosanu and Schuegraf. The appealed claims also stand rejected under 35 U.S.C. § 112, first paragraph, “enablement requirement.” Claim 5 additionally stands rejected under 35 U.S.C. § 112, second paragraph. We cannot sustain the stated rejections.

THE REJECTION FOR OBVIOUSNESS

As evidence of obviousness of the claimed subject matter, the examiner relies on the combined teachings of Chiang, Morosanu and Schuegraf. Like the claimed method, Chiang discloses a method for forming silicon nitride films on a substrate (i.e., a silicon semiconductor wafer) using a low pressure chemical vapor deposition (LPCVD) technique. However, to achieve thickness uniformity of a deposited silicon nitride film (column 5, lines 11 through 22), Chiang evacuates the reactor chamber to a pressure in the range of 0.2 to 1 Torr (column 4, lines 41 through 46), as contrasted to the claimed method (appealed claim 1) wherein the pressure is adjusted to “about 5 to about 100 Torr.” Recognizing this deficiency in the Chiang disclosure, the examiner has cited

Morosanu and Schuegraf as evidence that in chemical vapor deposition methods “increasing the pressure results in higher deposition rates”. See the answer, page 5. At the same time, the examiner also admits that it is well known in the art that decreasing the pressure in a chemical vapor deposition method results in “increased thickness uniformity” (answer, page 5). Thus, the examiner implicitly acknowledges that an <u>increase</u> in the operating pressure in a chemical vapor deposition method would have been expected to have an adverse effect on the film thickness uniformity of the deposited coating. Nevertheless, the examiner contends that when an increased deposition rate is critical to a specific application for producing a specifically desired final product, it would have been obvious to increase the process pressure to achieve a higher deposition rate. We find the examiner’s approach above to be problematical because the relied upon prior art references all relate to the field of semiconductor technology wherein film thickness uniformity is an essential and critical feature of the deposited silicon nitride coatings. Moreover, the examiner has pointed to no specific example involving a desired product in which

uniformity of coating thickness of a silicon nitride film is not required.

Appellants stress that higher operating pressures for depositing silicon nitride films in the semiconductor technology are to be avoided because at pressures higher than 0.25 Torr, non-uniform silicon nitride films are produced. As evidence factually supporting this contention, appellants refer to the disclosures of Chiang at column 5, lines 11 through 22 and the Sakai patent at column 5, lines 1 through 32. Indeed, the abstract of Sakai discloses that the reactor pressure for a
LPCVD process for producing a silicon nitride film of <u>uniform thickness</u> should be in the range of about 0.05 to about 0.25 Torr.

In light of the specific teachings in the art relating to the advantages of operating in a pressure range substantially lower than that claimed for depositing a silicon nitride coating having uniform thickness on a semiconductor wafer, we agree with appellants that one of ordinary skill in this art would not have been motivated to increase the pressure of Chiang’s process to the extent claimed. While

ordinarily it may be the case that the determination of optimum values for a result effective parameter of a prior art process is at least prima facie obvious, that conclusion depends upon what the prior art specifically discloses with respect to that parameter. In re Sebek, 465 F.2d 904, 906, 175 USPQ 93, 95 (CCPA 1972). Although Morosanu teaches that LPCVD processes, in general, have been carried out in the broad pressure range of 0.1-100 Torr, the more specific teachings in Chiang and Sakai direct one of ordinary skill in the art to a much lower pressure range than claimed for producing silicon nitride films having adequate thickness uniformity.

The examiner correctly notes that Schuegraf teaches that processes utilizing single wafer reactors for LPCVD processing provide for high deposition rates and exceptionally high uniformity. However, the examiner has not adequately and persuasively explained why one would have been led to operate such a single wafer reactor process within a pressure range as claimed for producing a silicon nitride coating. As appellants point out, single wafer reactors are used primarily

for the deposition of low temperature oxides and doped glasses.

In view of the foregoing, the examiner's rejection of the appealed claims for obviousness is reversed.

THE ENABLEMENT ISSUE

The appealed claims stand rejected under 35 U.S.C. § 112, first paragraph, "enablement requirement" on the asserted basis that appellants have not disclosed in the specification "all the critical parameters" to obtain a high deposition rate which is argued to be unexpected in this art. Observing that working examples 1 and 2 of the specification involve processing wherein silicon nitride is deposited under the identical conditions for two successive runs, the examiner contends that the identical deposition rate should be achieved for each run. Because this is not the case, the examiner apparently believes that appellants changed some undisclosed parameter between the successive runs reported in examples 1 and 2 that produced the difference in the deposition rates.

On the other hand, appellants submit that working examples 1 and 2 do teach one skilled in the art how to carry

out the process for depositing a silicon nitride film. Indeed, according to appellants, these examples simply demonstrate the expected normal variation in deposition rates between runs using their method. Appellants contend that slight differences in gas flow rates, the pressure of the reactor, temperature of the wafer as well as other parameters between successive runs adequately explain why the deposition rates were not identical. Keeping in mind that the deposition rate is reported in terms of angstroms

per minute, we agree with appellants that examples 1 and 2 of the present specification show that the present process is reproducible.

It is well established that the examiner has the "burden of giving reasons, supported by the record as a whole, why the specification is not enableling . . . Showing that the disclosure entails undue experimentation is part of the PTO's initial burden. . . ." In re Angstadt, 537 F.2d 498, 504, 190 USPQ 214, 219 (CCPA 1976). Based on the facts before us, we agree with appellants that the examiner has not met his burden of showing that the disclosure in the specification entails undue experimentation. Accordingly, we cannot sustain the stated rejection under 35 U.S.C. § 112, first paragraph, "enablement requirement."

INDEFINITENESS

Appealed claim 5 stands rejected under 35 U.S.C. § 112, second paragraph, on the grounds that the use of a generic term, "a silane", to introduce a Markush group is confusing when one member of the Markush group is the compound silane, SiH_4. Appellants argue and we agree, that "a silane" is a

recognized generic term which includes many silicon compounds inclusive of the compound silane (SiH_4) as well as other silane compounds as specified in the Markush group. The examiner should be aware that the purpose of the second paragraph of 35 U.S.C. § 112 is to basically ensure, with a reasonable degree of particularity, adequate notification of the metes and bounds of what is being claimed. See In re Hammack, 427 F.2d 1378, 1382, 166 USPQ 204, 208 (CCPA 1970). Accordingly, we reverse the examiner's rejection of appeal claim 5 under 35 U.S.C. § 112, second paragraph.

The decision of the examiner is reversed.

REVERSED

JOHN D. SMITH Administrative Patent Judge	)	
CHARLES F. WARREN Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
PAUL LIEBERMAN	)	

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