

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 13

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JIANMING FU, PEIJUN DING, and ZHENG XU

Appeal No. 2001-1812
Application No. 08/854,008

ON BRIEF

Before GARRIS, OWENS, and KRATZ, Administrative Patent Judges.
GARRIS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal which involves claims 1-16 and 18-28. These are all of the claims remaining in the application.

The subject matter on appeal relates to a sustained self-sputtering apparatus and method. In one embodiment, the apparatus and method include a biasable grid positioned between

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the target and support. According to the appellants, the presence of this grid increases plasma density and thereby promotes sustained self-sputtering. In another embodiment, a sputtering method is claimed which does not require the presence of a grid but which requires holding an interior of the sputtering chamber at a pressure of less than 1×10^{-6} Torr and applying sufficient electrical power to the target to self-sustain a target plasma. This appealed subject matter is adequately illustrated by independent apparatus claim 4 and independent method claim 27 which read as follows:

4. A sustained self-sputtering apparatus, comprising:
a vacuum chamber including a support for a substrate;
a sputtering target in said chamber facing said support;
a magnet assembly positioned on a side of said target opposite a central portion of said chamber;

a first power supply electrically biasing said target with respect to a portion of said chamber and capable of supporting a self-sustained plasma of ions sputtered from said target;

a grid positioned between said target and support and biasable at an electrical potential; and

a second power supply electrically biasing said support with respect to said grid.

27. A sputtering method in a sputtering chamber comprising a target, a magnet assembly on a side of said target, and a substrate support for supporting a substrate, said method comprising the steps of:

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igniting a plasma in said chamber adjacent to said target;

after said plasma has been ignited, holding an interior of said chamber at a pressure of less than 1×10^{-6} Torr and applying sufficient electrical power to said target to self-sustain a target plasma in a volume of said chamber adjacent to said magnet assembly; and

moving said magnet assembly over said side of said target, wherein said magnet assembly has an area between magnet portions thereof of no more than 25% of an area of said target.

The references set forth below are relied upon by the examiner as evidence of obviousness:

Mikalesen et al. (Mikalesen)	4,824,544	Apr. 25, 1989
Demaray et al. (Demaray)	5,330,628	Jul. 19, 1994
Hazuki (JP)	61-174725 ¹	Aug. 6, 1986
Tokuda Seisakusho (JP)	64-28291 ¹	Jan. 31, 1989
Tokyo Electron (JP)	2-298263 ¹	Dec. 10, 1990
Ogawa et al. (Ogawa) (JP)	3-140467 ¹	Jun. 14, 1991
Naoe (JP)	3-240944 ¹	Oct. 28, 1991
Igarashi (JP)	5-195213 ¹	Aug. 3, 1993
Shiraishi (JP)	5-311419 ¹	Nov. 22, 1993
Asamaki (JP)	7-126844 ¹	May 16, 1995

Posadowski et al. (Posadowski), "Sustained self-sputtering using a direct current magnetron source," J. Vac. Sci. Technol A, Vol. 11, No. 6, pp. 2980-2984 (1993).

Asamaki et al. (Asamaki), "Copper Self-Sputtering by Planar Magnetron," Jpn. J. Appl. Phys., Vol. 33, pt. 1, No. 5A, pp. 2500-2503 (1994).

¹ We refer to these Japanese references with the respective names used by the examiner, and our understanding of these references is based upon the respective English translations thereof.

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Claims 1, 2, 4, 5, 7, 19, 20 and 23-25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Shiraishi or Hazuki or Igarashi or Mikalesen in view of Demaray, the Asamaki article and the Posadowski article; the remaining claims on appeal are correspondingly rejected over these references and further in view of various combinations of the other previously-listed references relied upon by the examiner.

We refer to the brief and to the answer for a complete discussion of the contrary viewpoints expressed by the appellants and by the examiner concerning the above noted rejections.

OPINION

For the reasons set forth below, we cannot sustain any of the rejections advanced by the examiner on this appeal except for the rejections of independent claim 27 and of claim 28 which depends therefrom.

Claims 1-16 and 18-26 are directed to a sustained self-sputtering apparatus or method which includes a biasable grid positioned between the target and support. With respect to these claims, it is the examiner's basic position that each of the "primary" references to Shiraishi or Hazuki or Igarashi or Mikalesen discloses an apparatus which is not sustained self-sputtering as here claimed but which includes a biasable grid

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positioned between the target and support. According to the examiner, the Asamaki article and the Posadowski article supply the aforementioned sustained self-sputtering deficiency of the primary references, and "it would be [sic, would have been] obvious to modify the primary references by utilizing **self-sputtering conditions** of Asamaki . . . and Posadowski . . . since it allows for good filling of a contact hole" (answer, page 15).

More specifically, the examiner states:

it is agreed that the primary references do not suggest the conditions required for generating sustained self sputtering but the secondary references of Asamaki ... and Posadowski ... teach the **conditions** needed for **sustained self sputtering** with the **benefit** being that **contact holes can be filled uniformly** which the primary references also recognize as important [answer, page 16].

The examiner's position is not well taken.

As correctly argued by the appellants and seemingly appreciated by the examiner, the conventional sputtering technique of the respective primary references is distinct from the sustained self-sputtering technique of Asamaki and Posadowski. Contrary to the examiner's belief, it would not have been obvious to combine these techniques in the fashion proposed by the examiner simply because the primary and secondary references disclose common desideratum such as the effective filling of contact holes. As properly indicated in the brief,

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the applied prior art contains no teaching or suggestion that the respective techniques of the primary and secondary references are individually insufficient to achieve the desired results or that the achievement of such results would have been enhanced by combining these techniques in the manner proposed by the examiner. Indeed, there is merit in the appellants' argument that the sustained self-sputtering techniques of Asamaki and Posadowski do not exhibit the problems which are taught by at least some of the primary references as being solved via the "grids" disclosed therein.

For example, the control plates or "grid" of Shiraishi and the sustained self-sputtering technique of Asamaki both direct the flow of sputtering atoms so that contact holes in substrates are effectively filled. Based on the disclosures of these references, an artisan with ordinary skill would have considered Shiraishi's "grid" and Asamaki's self-sputtering technique to be individually effective in obtaining this desired result and thus would not have considered combining these features as the examiner urges because such a combination seemingly would be redundant. Similarly, the mesh type control electrode or "grid" of Hazuki performs the function of capturing secondary electrons to prevent them from reaching and adversely affecting the

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substrate. There is nothing in either Asamaki or Posadowski which reflects that the self-sputtering techniques thereof suffer from any such problem involving "secondary electrons." It follows that no basis exists for combining the teachings of Hazuki with the teachings of Asamaki and Posadowski.

In addition to the foregoing, we find nothing and the examiner points to nothing in the applied prior art which would have given an artisan a reasonable expectation that the combination proposed by the examiner would have been successful. For all we know, based on the applied reference evidence, the primary reference feature of a biasable grid positioned between the target and substrate would have been incompatible with the secondary reference feature of a sustained self-sputtering technique. That is, an artisan having read the applied references might have as easily expected the presence of such a grid to inhibit a self-sputtering operation rather than enhance it as taught by the appellants. We here remind the examiner that obviousness under section 103 requires not only a suggestion to combine the applied reference teachings but also a reasonable expectation that such a combination would be successful. See In re O'Farrell, 853 F.2d 894, 903-04, 7 UPSQ2d 1673, 1680-81 (Fed. Cir. 1988).

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For the reasons set forth above, we cannot sustain any of the examiner's section 103 rejections of claims 1-16 and 18-26.

We reach a different conclusion regarding the section 103 rejections of claims 27 and 28. Concerning these rejections, the only argument advanced by the appellants is that "Claim 27 . . . recites a microTorr of pressure for sustained self-sputtering" and that "the [applied prior] art does not teach such a low pressure, and hence this claim must be held allowable" (brief, page 12). As properly indicated by the examiner, however, the abstract of Asamaki expressly teaches that "self-sputtering of copper is performed in a wide pressure range of 10^{-2} Pa to 10^{-4} Pa." The appellants' apparent belief that Asamaki's lower most pressure of 10^{-4} Pa (which correspond to 0.75×10^{-6} Torr and thus falls within the here claimed range) relates to reactor capability rather than operational pressure is not well taken since it is contrary to the previously quoted, express disclosure of Asamaki. In any event, if nothing else, Asamaki evinces that the parameter of pressure constitutes an art-recognized variable in a sustained self-sputtering operation, and it is generally considered that it would have been obvious for an artisan to determine workable or even optimum values for such an art-recognized, result-effective variable. In re Woodruff, 919

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F.2d 1575, 1578, 16 USPQ2d 1934, 1936-37 (Fed. Cir. 1990); In re Boesch, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980); In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Under these circumstances, we will sustain the examiner's section 103 rejections of independent claim 27 and of nonargued dependent claim 28.

The decision of the examiner is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

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Administrative Patent Judge)	
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