Paper No. 45

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte TERRY T. SHENG

Appeal No. 2001-0929
Application No. 08/697,321

HEARD: February 7, 2002

Before WALTZ, TIMM, and SMITH, Administrative Patent Judges.
WALTZ, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the examiner's final rejection of claims 1 through 5, 8 through 10, and 25 through 32 (see the Brief, page 3; Answer, page 2). Claims 6, 7 and 22 through 24 are the remaining claims pending in this application and stand allowed by the examiner (Brief, page 2; Answer, page 3).

According to appellant, the invention is directed to methods and apparatus for ionizing gas molecules and accelerating and implanting the ions into a workpiece, where a plurality of direct

current (DC) voltage pulses are applied to repeatedly relatively bias the conductive workpiece support and conductive wall portion to ionize gas molecules injected into the treatment chamber to create a non-continuous, pulsed DC plasma, and to accelerate and implant ions from the plasma into the workpiece (Brief, page 3). A copy of illustrative independent claims 1 and 27 are attached as an Appendix to this decision.[1]

The examiner has relied upon the following references as evidence of obviousness:

Nakayama et al. (Nakayama)	4,937,205	Jun. 26, 1990
Gruen	5,015,493	May 14, 1991
Chan	5,126,163	Jun. 30, 1992
Yoshida	5,206,180	Apr. 27, 1993
Kruger et al. (Kruger) (filed Jun. 15, 1992)	5,286,676	Feb. 15, 1994
Shohet (filed Dec. 8, 1992)	5,289,010	Feb. 22, 1994
Matossian et al. (Matossian) (filed Dec. 23, 1992)	5,374,456	Dec. 20, 1994

Claims 27-32 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Gruen in view of Chan and Matossian (Answer, page 4). Claims 1, 5, 10 and 25-32 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Nakayama in view of Chan and Kruger

[1]Claims 27-32 were "substantially copied" from claims 1, 2, 4, 10, 12 and 14 of Shao et al. (Shao), U.S. Patent No. 5,654,043, which issued on Aug. 5, 1997, from an application filed on Oct. 10, 1996 (Brief, page 2).

(Answer, page 12). Claims 2-4 and 8-9 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the references as applied against claims 1, 5, 10 and 25-32 further in view of Shohet or Yoshida (Answer, page 18). We *reverse* all of the examiner's rejections on appeal essentially for the reasons stated in the Brief, Reply Brief, and as set forth below.

OPINION

A. The Rejection over Gruen, Chan and Matossian

The examiner finds that Gruen teaches a pulsed plasma process for coating conductive work pieces, specifically citing Figures 2-3 of Gruen where ion plating is taught (Answer, pages 4-5). The examiner recognizes that a "main difference" between Gruen and claims 27-32 on appeal is that the chamber walls are not taught to be conductive or biased relative to the workplace (Answer, page 6). However, the examiner finds that Gruen implies that the chamber walls are conductive through the disclosure of insulator sleeves and further cites Chan to show grounding of the conductive chamber walls when pulsed negative voltage is applied to the generic workpiece (*id.*). The examiner also states that Chan shows implanting with pulsed D.C. "which is now a specifically claimed difference from Gruen." *Id.* Finally, the examiner recognizes that "ion implanting is a difference from Gruen, who teaches coating and

sputtering plasma processes equivalently." Answer, page 5. Therefore the examiner applies Matossian for the teaching that relationships between ion plating, ion sputtering, and ion implanting are old and well known in the plasma art and differ only in the amount of ion bombardment due to varied energies, accelerations and materials used (Answer, page 7). Accordingly, the examiner finds that Matossian supplies "motivation and shows that the above combination of Gruen and Chan would have been expected to be effective for ion implantation processes" (Answer, page 8). We disagree.

As admitted by the examiner, Gruen is directed to coating conductive workpieces by ionized vapors, i.e., a physical vapor deposition method (Answer, page 5; Gruen, col. 1, ll. 60-65). Chan is directed to ion implantation with grounding of the conductive chamber walls when pulsed negative voltage is applied to the workpiece (Answer, page 6) but the examiner has failed to present any convincing evidence or reasoning to support the proposed combination of Gruen and Chan. Matossian discloses the differences between ion implantation, ion mixing, and ion deposition (col. 1, ll. 37-54) and teaches that "plasma processing" is a term of art that encompasses all of these processes (col. 3, ll. 18-21). However, Matossian further teaches that these individual processes

"are distinct but related." See col. 3, ll. 21-22. While Matossian teaches that the apparatus used in these processes are "similar" (col. 3, ll. 30-33), the examiner has not pointed to any teaching or showing in Matossian that these processes of ion bombardment are so similar that one of ordinary skill in the plasma processing art could modify one type of process with steps from another type of process. Accordingly, we determine that the examiner has not established any convincing motivation or reasoning to support the proposed combination of references. *See In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Furthermore, the examiner has not presented any convincing evidence or reasoning why one of ordinary skill in the art would modify the ion coating process desired by Gruen with the ion implantation process of Chan.

Additionally, the examiner applies Chan to show implanting with a pulsed D.C. voltage (Answer, page 6). However, Chan teaches the use of two sources, the first a pulsed arc source to create the plasma and the second source a D.C. voltage to accelerate and implant the ions (col. 4, l. 27-col. 5, l. 5). The examiner has failed to present any convincing evidence or reasoning why one of ordinary skill in the art would have only used the second source of Chan in the process of Gruen. *See Dembiczak, supra.*

For the foregoing reasons and those stated in the Brief and Reply Brief, we determine that the examiner has not established a *prima facie* case of obviousness in view of the reference evidence. Therefore we need not reach the issue of appellant's evidence of non-obviousness, i.e., the Declarations under 37 CFR § 1.132 by Lee and Liebert (Exhibits B and C attached to the Brief). *See In re Geiger,* 815 F.2d 686, 688, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987). Accordingly, the examiner's rejection of claims 27-32 under 35 U.S.C. § 103(a) over Gruen in view of Chan and Matossian is reversed.

B. The Rejection over Nakayama, Chan and Kruger

The examiner finds that Nakayama teaches implanting dopants in a semiconductor substrate via a pulsed plasma where the intermittently applied R.F. power has a D.C. potential of -700 volts, thus lacking the D.C. voltage required by the claims on appeal (Answer, page 12). The examiner applies Chan as discussed above, for the teaching of ion implantation on a substrate intermittently charged with a negative D.C. potential via direct application of D.C. (Answer, page 16). The examiner further applies Kruger for the teaching that wafers to be treated by ion implanting or ion back sputtering may use an electrical bias

source that is a R.F. source resulting in a D.C. self bias or alternatively a D.C. source may equivalently be used (Answer, page 13).

We incorporate our remarks about Chan from our discussion above, namely that Chan teaches a separate source for generation of the plasma as well as a source for ion acceleration and implantation while the claims on appeal require the D.C. voltage pulses to create a plasma, accelerate and implant the ions. We again note that the examiner has not presented any convincing evidence or reasoning to support the proposed combination of Nakayama with Chan.

Appellant correctly argues that Kruger does not teach where its plasma "comes from" and thus there is no convincing evidence or reasoning why the D.C. source of Kruger would have been used in the process of Nakayama to produce the requirements of the claimed process, namely create a plasma and accelerate and implant the ions (Brief, page 15). Kruger discloses an "activated N_2 plasma" but fails to teach how this plasma was produced (see col. 6, ll. 32-43). Furthermore, we agree with appellant that Kruger does not describe or suggest pulsed ion implantation (R.F. or D.C.)(Brief, page 15). The examiner merely states that these failures of Kruger "does not negate the demonstrated equivalence" but provides no

convincing evidence or reasoning to support this statement, other than referring to Nakayama and Chan (Answer, page 14).

For the foregoing reasons and those set forth in the Brief and Reply Brief, we determine that the examiner has not established a *prima facie* case of obviousness in view of the reference evidence. As previously discussed, we therefore need not consider appellant's evidence of non-obviousness. *See Geiger, supra.* Accordingly, the examiner's rejection of claims 1, 5, 10 and 25-32 under 35 U.S.C. § 103(a) over Nakayama in view of Chan and Kruger is reversed.

C. The Rejection over Nakayama, Chan, Kruger, Shohet and Yoshida

We incorporate the analysis of the Nakayama, Chan and Kruger references as discussed above. The examiner applies Shohet and Yoshida for the teaching that BF_3 was a known viable alternate source gas for the boron doping of Nakayama (Answer, page 18). Accordingly, the Shohet and Yoshida references do not remedy the deficiencies discussed above in the proposed combination of references.

The examiner also applies Shohet as "cumulative evidence" that it would have been obvious to use either RF or D.C. voltage sources for ion implantation with expectations of success (*id.*). However, Shohet suffers from the same deficiency as Kruger and Chan, namely

that other sources are used to create the plasma while a D.C. voltage source is used to accelerate and implant the ions (Brief, page 17; Shohet, col. 3, ll. 46-47; col. 6, ll. 14-16 and 37-42).

For the foregoing reasons and those stated in the Brief and Reply Brief, we determine that the examiner has not established a *prima facie* case of obviousness in view of the reference evidence. Therefore we need not reach the issue of appellant's evidence of non-obviousness. *See Geiger, supra.* Accordingly, the examiner's rejection of claims 2-4 and 8-9 under 35 U.S.C. § 103(a) over Nakayama in view of Chan and Kruger further in view of Shohet or Yoshida is reversed.

D. Summary

The rejection of claims 27-32 under 35 U.S.C. § 103(a) over Gruen in view of Chan and Matossian is reversed. The rejection of claims 1, 5, 10 and 25-32 under 35 U.S.C. § 103(a) over Nakayama in view of Chan and Kruger is reversed. The rejection of claims 2-4 and 8-9 under 35 U.S.C. § 103(a) over Nakayama in view of Chan and Kruger further in view of Shohet or Yoshida is reversed.

The decision of the examiner is reversed.

REVERSED

THOMAS A. WALTZ Administrative Patent Judge	)	
CATHERINE TIMM Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
JEFFREY T. SMITH Administrative Patent Judge	)	

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APPENDIX

1. A process for implanting ions into a semiconductor wafer, the process comprising:

supporting the semiconductor wafer on a first electrode in a chamber;

injecting a gas into the chamber, the gas comprising dopants to be implanted into the semiconductor wafer;

sequentially providing a plurality of first voltage pulses to the first electrode, each of the first voltage pulses being direct current (DC) voltage pulses less than 10 kV in magnitude, each of the first voltage pulses simultaneously ionizing the gas to create a plasma adjacent to said semiconductor wafer and accelerate and implant ions from the plasma into the semiconductor wafer; and

removing all plasma-inducing electric fields after each of the first voltage pulses to extinguish the plasma between each of the first voltage pulses.

27. A method of treating a workpiece comprising steps of:

inserting the workpiece into an interior of a treatment chamber and supporting the workpiece on a conductive workpiece support such that a treatment surface of the workpiece faces a treatment region in the interior of the treatment chamber, the treatment chamber having a conductive wall portion that bounds the interior of the treatment chamber;

injecting a treatment material comprising neutrally uncharged gas molecules into the treatment chamber such that the gas molecules occupy the treatment region; and

repeatedly relatively biasing the conductive workpiece support and the conductive wall portion of the treatment chamber by applying D.C. voltage pulses to ionize the gas molecules injected into the treatment chamber and to accelerate and implant resulting charged particles into the workpiece.