Paper No. 22

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte XIANG YU YAO

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Appeal No. 2001-1821
Application No. 09/098,311

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ON BRIEF

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Before GARRIS, OWENS, and DELMENDO, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This appeal is from the refusal to allow claims 14-20 and 22-32 as amended after final rejection. These are all of the claims remaining in the application.

THE INVENTION

The claimed invention is directed toward a plasma enhanced chemical vapor deposition system for forming a silicon carbide

film on a substrate. Claim 14 is illustrative:

14. A substrate processing system, comprising:

a vacuum chamber comprising a reaction zone, a substrate holder for positioning a substrate in the reaction zone, and a vacuum system;

a gas distribution system connecting the reaction zone of the vacuum chamber to supplies of a silicon source, a carbon source, and a noble gas;

a mixed frequency RF generator coupled to the gas distribution system for generating a plasma in the reaction zone;

a controller comprising a computer coupled to the vacuum chamber, the gas distribution system, and the RF generator; and

a memory coupled to the controller, the memory comprising a computer usable medium comprising a computer readable program code for conducting a process comprising generating and maintaining a plasma from a mixture of the silicon source, the carbon source, and the noble gas using mixed frequency RF power.

THE REFERENCES

Bartha et al. (Bartha)	5,162,133	Nov. 10, 1992
Ravi	5,807,785	Sep. 15, 1998 (filed Aug. 2, 1996)

THE REJECTION

Claims 14-20 and 22-32 stand rejected under 35 U.S.C. § 103 as being unpatentable over Ravi in view of Bartha.

OPINION

We affirm the aforementioned rejection.

The appellant states that the claims stand or fall together (brief, page 3). We therefore limit our discussion to one claim,

i.e., claim 14. *See In re Ochiai*, 71 F.3d 1565, 1566 n.2, 37 USPQ2d 1127, 1129 n.2 (Fed. Cir. 1995); 37 CFR § 1.192(c)(7)(1997).

Ravi discloses a substrate processing system comprising a vacuum chamber (15) comprising a reaction zone (col. 3, lines 43-47), a substrate holder (12) for positioning a substrate in the reaction zone (col. 3, lines 51-52), a vacuum system (col. 4, lines 10-12), a gas distribution system (col. 3, lines 61-63) connecting the reaction zone to supplies of a silicon source and a noble gas (col. 7, lines 41-47; col. 9, lines 41-42; fig. 1A), a mixed frequency RF generator coupled to the gas distribution system for generating a plasma in the reaction zone (col. 4, lines 21-28), a controller comprising a computer coupled to the vacuum chamber, the gas distribution system and the RF generator (col. 4, lines 52-57), and a memory coupled to the controller (col. 4, lines 58-61). The memory comprises a computer readable program code for conducting a process comprising generating and maintaining a plasma from the supplied gas mixture (col. 5, lines 34-36).

Ravi does not disclose a carbon source. In Ravi's exemplified use of the substrate processing system, a silicon dioxide layer is formed from tetraethylorthosilicate (TEOS),

ozone and a fluorine-containing compound by plasma enhanced chemical vapor deposition (col. 8, lines 57-61). Ravi, however, indicates that the substrate processing system has uses other than the exemplified use. That is, Ravi teaches that the system is useful for sputtering as well as chemical vapor deposition, and indicates that it is useful for other processes including both thermal and plasma enhanced processes (col. 4, lines 15-16; col. 6, lines 39-55). Ravi refers to a particular subatmospheric CVD process, i.e., one which uses TEOS and ozone at 350-500°C, as being "typical" (col. 4, lines 19-21). Hence, one of ordinary skill in the art would have been led by the reference to use the substrate processing system for other thermal and plasma enhanced processes, particularly plasma enhanced processes wherein, as taught by Ravi, RF energy is used to generate the plasma (col. 4, lines 22-28). One such process is the formation of silicon carbide from a mixture of a silicon source, a carbon source and helium as taught by Bartha (col. 3, lines 12-25). One of ordinary skill in the art, therefore, would have been motivated to include in Ravi's substrate processing system a carbon source so that the system is useful for forming a silicon carbide layer. Bartha does not disclose using mixed frequency RF energy to generate the plasma. However, Bartha teaches that the energy can

be either low frequency or 13.56 MHz high frequency RF (col. 3, lines 12-18),[1] and Ravi teaches that both single and mixed frequency RF are useful for generating plasmas for substrate processing in the disclosed system (col. 4, lines 19-28). Hence, one of ordinary skill in the art would have had a reasonable expectation of success in using a carbon source in combination with Ravi's mixed frequency RF generator such that the system is capable of forming a silicon carbide layer. Because the applied prior art would have provided one of ordinary skill in the art with both a motivation to include in Ravi's substrate processing system a carbon source such that the system is capable of forming a silicon carbide layer, and would have provided such a person with a reasonable expectation of success in doing so, such a substrate processing system would have been *prima facie* obvious to one of ordinary skill in the art. *See In re Vaeck*, 947 F.2d 488, 493, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991)*; In re O'Farrell*, 853 F.2d 894, 902, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988).

The appellant argues that "it would not be obvious to one of ordinary skill in the art to generate a plasma using a mixed frequency RF generator from a mixture of a silicon source, a

[1] The appellant states that about 13.56 MHz is high frequency and about 350 KHz is low frequency (specification, page 14, lines 11-12).

carbon source, and a noble gas because *Ravi* does not teach or suggest any benefits of using a mixed frequency RF power over a single frequency power" (reply brief, page 2). This argument is not persuasive because Ravi indicates that either single or mixed frequency RF power is effective for decomposing reactive species introduced into the chamber (col. 4, lines 25-28). Hence, the reference would have fairly suggested, to one of ordinary skill in the art, use of either single or mixed frequency RF power.

For the above reasons, we conclude that the claimed invention would have been obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

DECISION

The rejection of claims 14-20 and 22-32 under 35 U.S.C. § 103 over Ravi in view of Bartha is affirmed.

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

AFFIRMED

Bradley R. Garris Administrative Patent Judge	)	
Terry J. Owens Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
Romulo H. Delmendo Administrative Patent Judge	)	

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