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(54) Title: ELECTRON BEAM ENHANCED NITRIDING SYSTEM (EBENS)

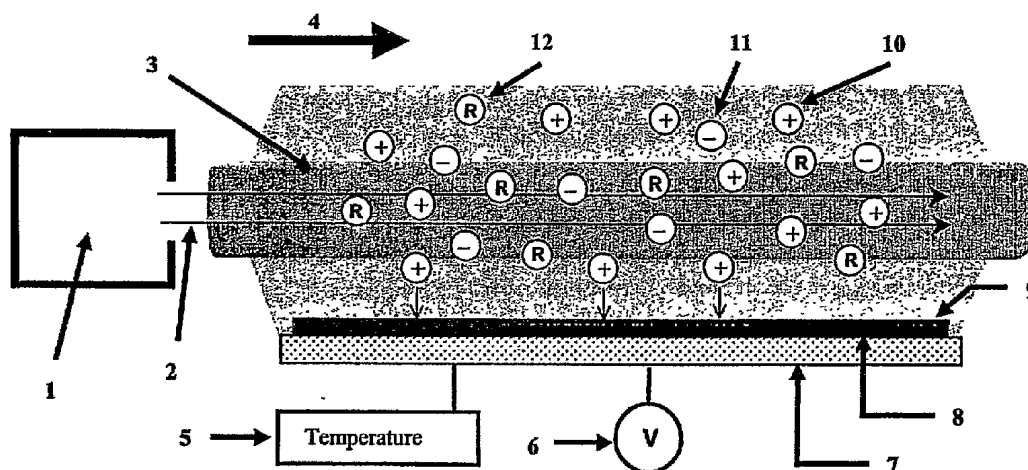


Figure 1. EBENS Schematic: (1) Beam source; (2) Electron beam; (3) Beam-generated plasma; (4) Direction of external magnetic field; (5) Temperature control; (6) Bias voltage (+ or -); (7) Conducting electrode; (8) Substrate; (9) Nitride layer; (10) Positive ion; (11) Electron; (12) Neutral radical;

(57) Abstract: An electron beam enhanced nitriding system that passes a high-energy electron beam (2) through nitrogen gas to form a low electron temperature plasma (3) capable of delivering nitrogen ions (10) and radicals (12) to a substrate to be nitrided. The substrate can be mounted on an electrode (7), and the substrate (8) can be biased and heated.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/22260

A. CLASSIFICATION OF SUBJECT MATTER

IPC: C23C 16/34(2006.01),16/453(2006.01),16/503(2006.01)

USPC: 118/723FE;427/569

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : Please See Continuation Sheet

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,762,756 A (BERGMANN et al) 09 August 1988 (09.08.88), entire document, specifically figure 1.	1-4, 6-13, 15-18 ----- 1-24
X --- Y	US 6,703,081 B2 (KARNER et al) 09 March 2004 (09.03.04), entire document, specifically figure 1.	1, 3, 4, 6-10, 12, 13, 15, 16, 18, ----- 1-24
X --- Y	US 5,874,807 A (NEGER et al) 23 February 1999 (23.02.1999), entire document, specifically, figure 1.	1-9 ----- 1-24

Further documents are listed in the continuation of Box C.

See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,340,621 A (MATSUMOTO et al) 23 August 1994 (23.08.94), entire document.	1, 3, 4, and 6-9 ----- 1-24
Y	US 6,416,577 B1 (SUNTOLOA et al) 09 July 2002 (09.07.02) figure.	19-24

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Continuation of B. FIELDS SEARCHED Item 1:

118/723FE,715, 723R, 723EB, 723HC, 723DC, 723E, 723ER; 156/345.39, 345.4, 345.43, 345.46; 315/111.41, 111.71; 427/569

Continuation of B. FIELDS SEARCHED Item 3:

US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT; IBM_TDB

search terms: electron beam, low electron temperature plasma, thin, wide, beam, hollow, substrate, workpiece, work piece, interior, pipe, tube, plasma, tank, container, gas tank, bias\$4, heat\$4, ferrous, aluminum