US006896775B2

(12) **United States Patent**
Chistyakov

(10) **Patent No.:** **US 6,896,775 B2**
(45) **Date of Patent:** **May 24, 2005**

(54) **HIGH-POWER PULSED MAGNETICALLY ENHANCED PLASMA PROCESSING**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 386 days.

(21) Appl. No.: **10/065,551**

(22) Filed: **Oct. 29, 2002**

(65) **Prior Publication Data**

US 2004/0082187 A1 Apr. 29, 2004

(51) **Int. Cl.**[7] **C23C 14/34**; C23F 1/00

(52) **U.S. Cl.** **204/192.32**; 204/298.31; 204/298.33; 204/298.34; 204/298.37; 216/67; 216/71; 156/345.43; 156/345.44; 156/345.46

(58) **Field of Search** 204/192.32, 298.31, 204/298.33, 298.34, 298.37; 216/67, 71; 156/345.43, 345.44, 345.46

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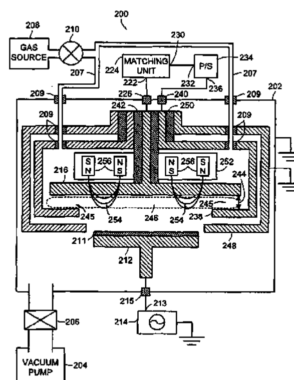
(57) **ABSTRACT**

Magnetically enhanced plasma processing methods and apparatus are described. A magnetically enhanced plasma processing apparatus according to the present invention includes an anode and a cathode that is positioned adjacent to the anode. An ionization source generates a weakly-ionized plasma proximate to the cathode. A magnet is positioned to generate a magnetic field proximate to the weakly-ionized plasma. The magnetic field substantially traps electrons in the weakly-ionized plasma proximate to the cathode. A power supply produces an electric field in a gap between the anode and the cathode. The electric field generates excited atoms in the weakly-ionized plasma and generates secondary electrons from the cathode. The secondary electrons ionize the excited atoms, thereby creating a strongly-ionized plasma. A voltage supply applies a bias voltage to a substrate that is positioned proximate to the cathode that causes ions in the plurality of ions to impact a surface of the substrate in a manner that causes etching of the surface of the substrate.

37 Claims, 18 Drawing Sheets



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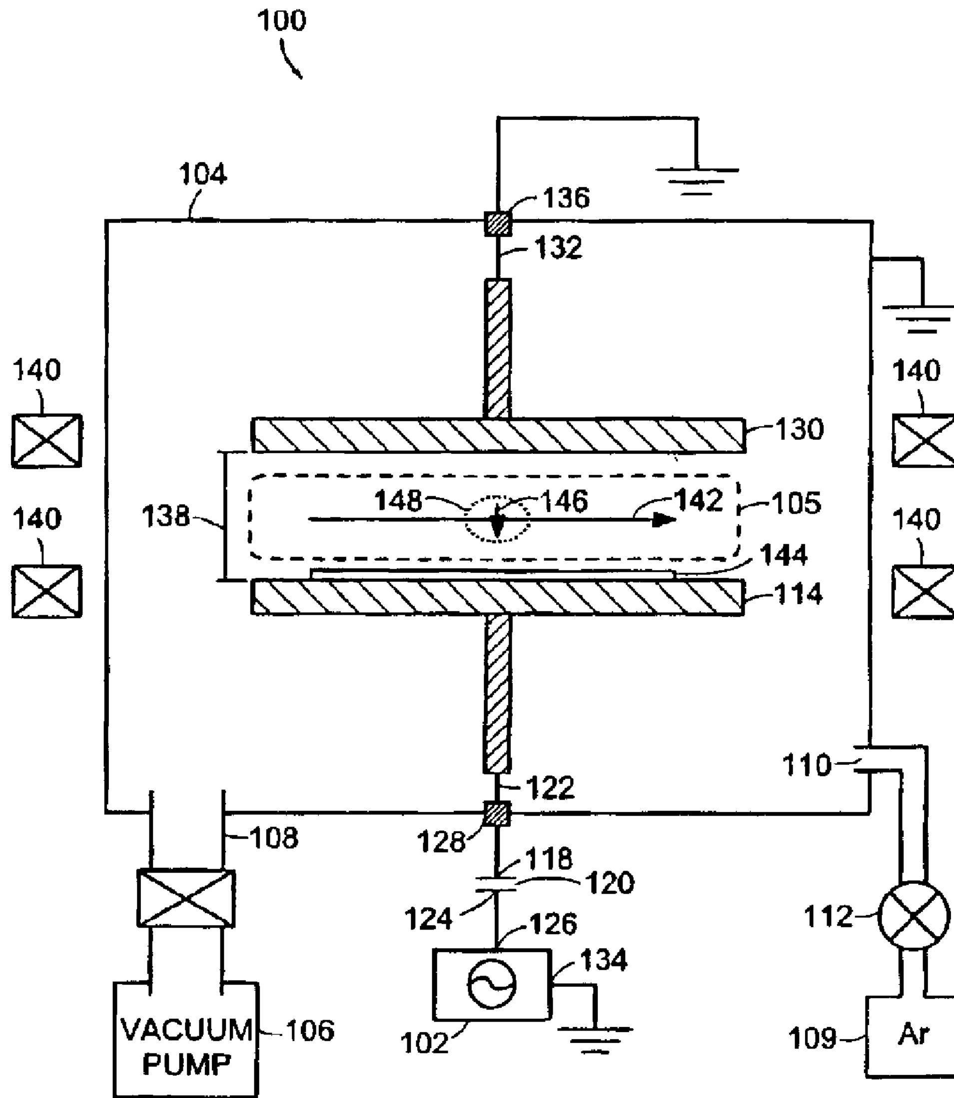

FIG. 1
PRIOR ART

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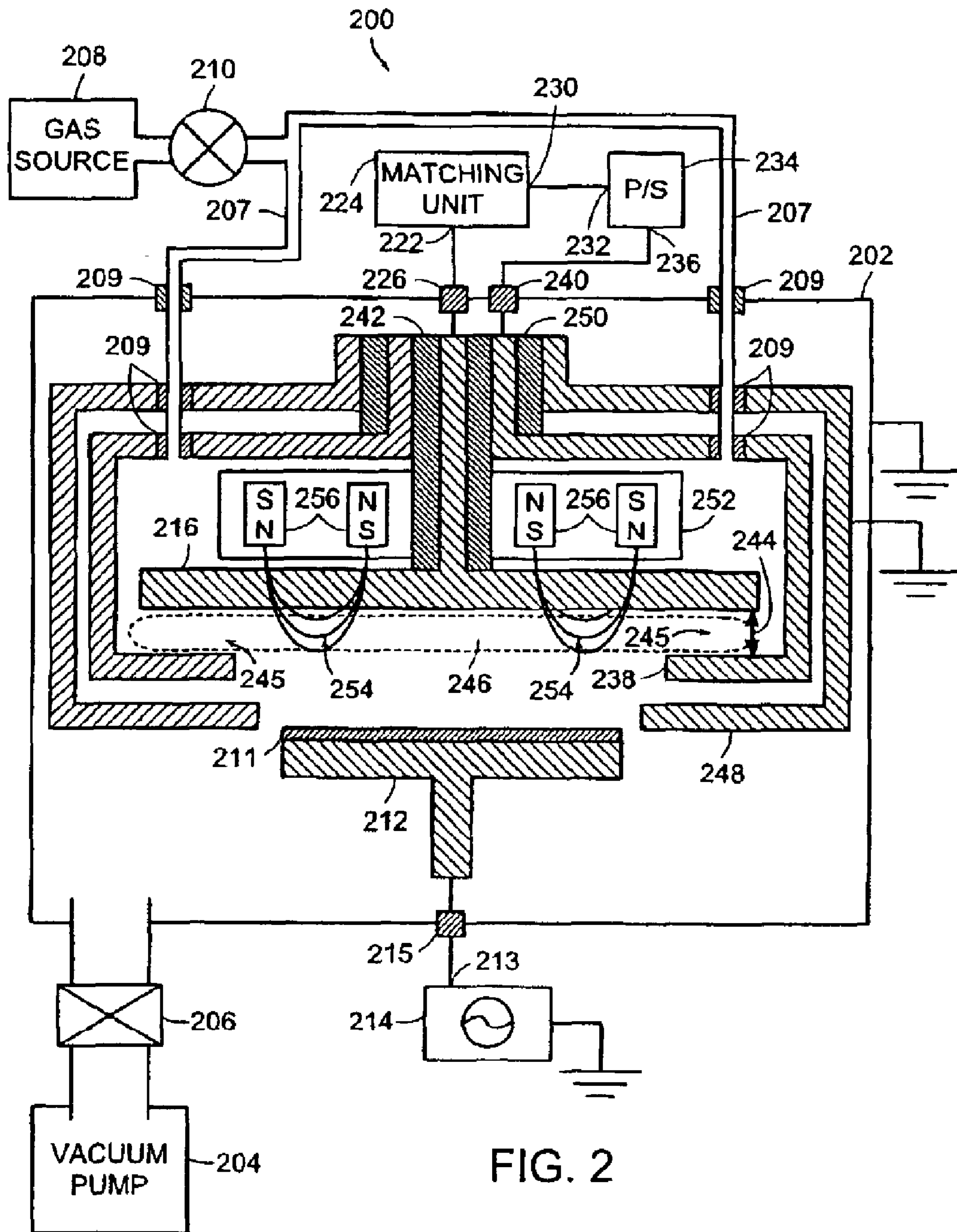

FIG. 2

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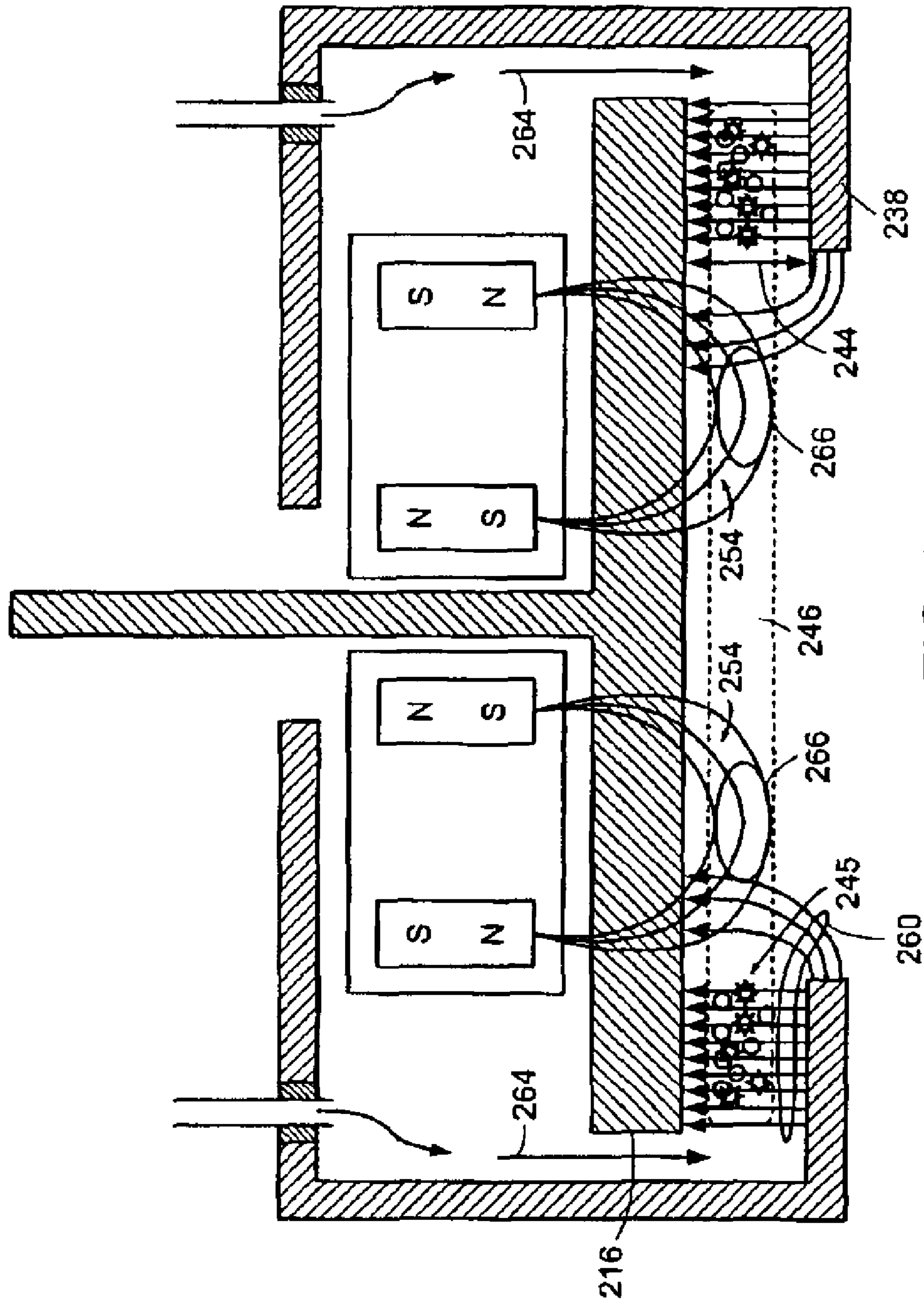

FIG. 3

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