



(12) **United States Patent**
Chistyakov

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(54) **HIGH DEPOSITION RATE SPUTTERING**

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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 0 days.

This patent is subject to a terminal disclaimer.

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(57) **ABSTRACT**

Methods and apparatus for high-deposition sputtering are described. A sputtering source includes an anode and a cathode assembly that is positioned adjacent to the anode. The cathode assembly includes a sputtering target. An ionization source generates a weakly-ionized plasma proximate to the anode and the cathode assembly. A power supply produces an electric field between the anode and the cathode assembly that creates a strongly-ionized plasma from the weakly-ionized plasma. The strongly-ionized plasma includes a first plurality of ions that impact the sputtering target to generate sufficient thermal energy in the sputtering target to cause a sputtering yield of the sputtering target to be non-linearly related to a temperature of the sputtering target.

40 Claims, 13 Drawing Sheets

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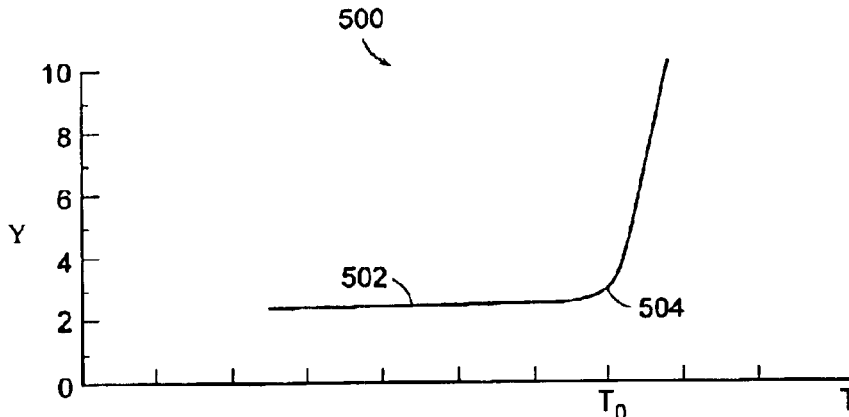
(52) **U.S. Cl.** **204/192.12; 204/192.13; 204/298.03; 204/298.06; 204/298.07; 204/298.08; 204/298.14; 204/298.19**

(58) **Field of Search** **204/192.12, 192.13, 204/298.03, 298.06, 298.07, 298.08, 298.14, 298.19**

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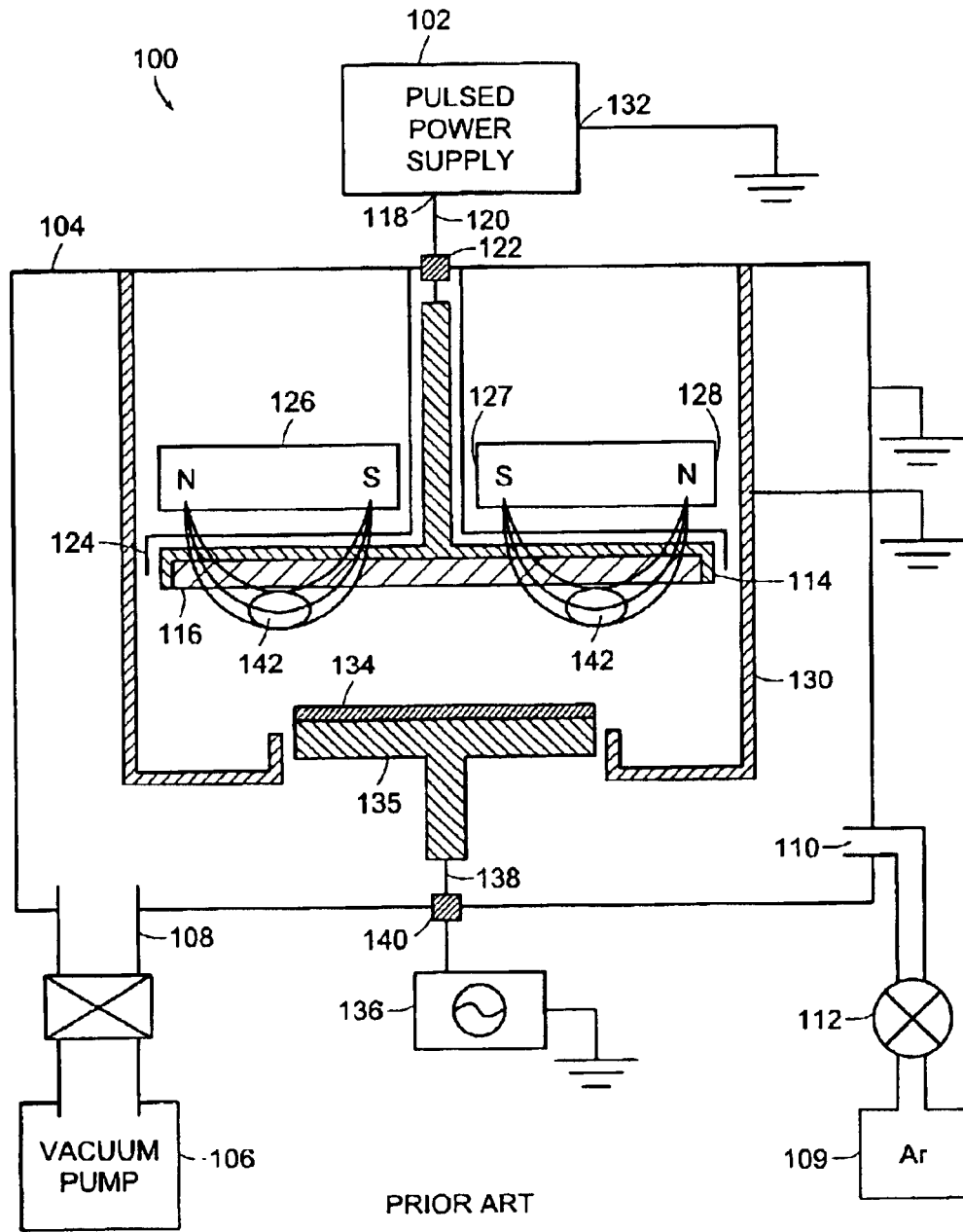
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PRIOR ART
FIG. 1

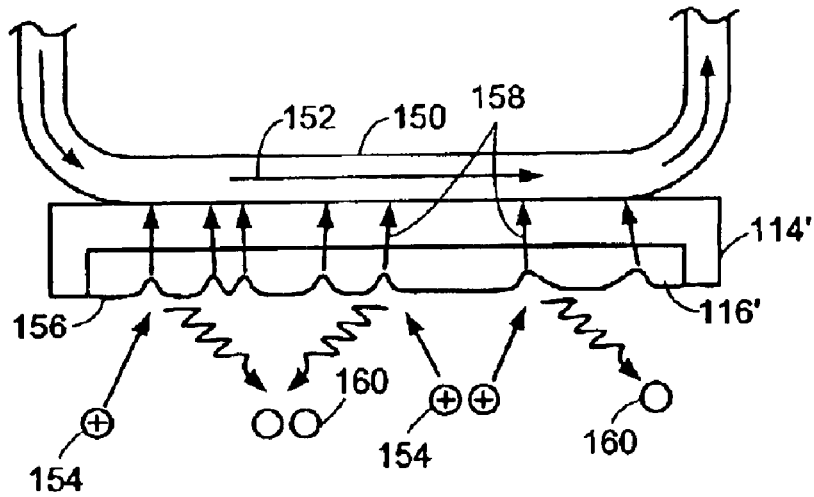


FIG. 2
PRIOR ART

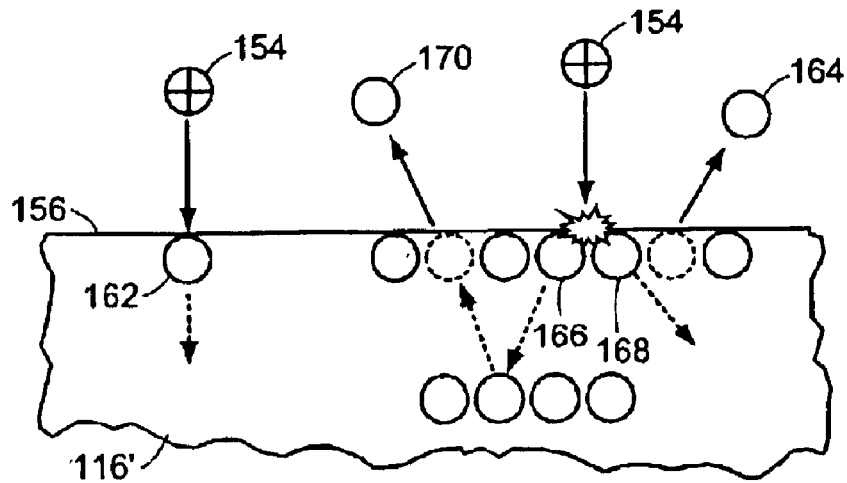


FIG. 3
PRIOR ART

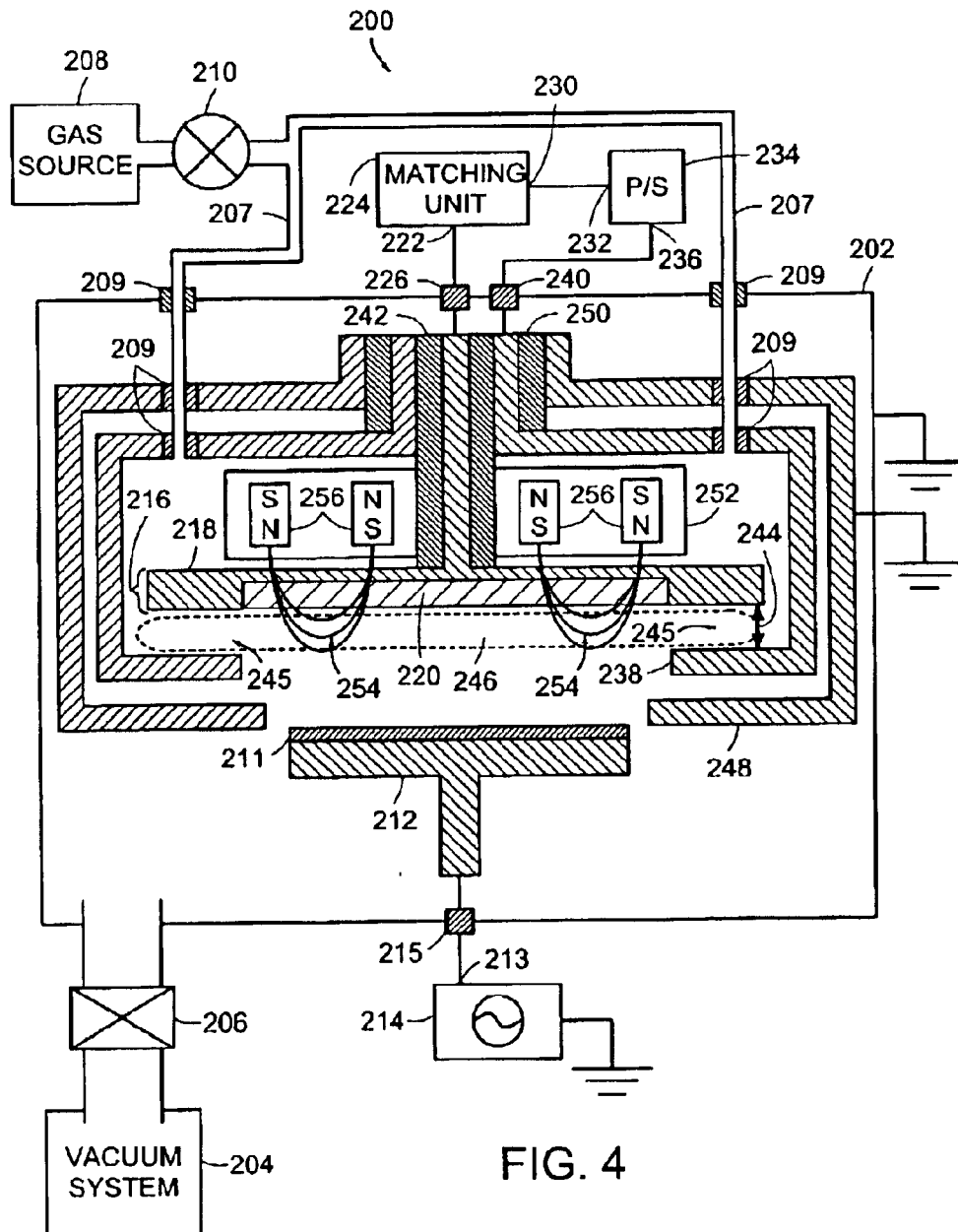


FIG. 4

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