Pulsed Plasma Source for Enhanced Ion Implantation and Deposition

C. Diplasu, A. Surmeian, A. Groza, M. Ganciu,
National Institute for Laser, Plasma and Radiation Physics, P.O.Box MG 36, R-76900, Bucharest, Romania

The implanted ion dose, the main characteristic of Plasma Immersion Ion implantation & Deposition (PIII&D), increases with background plasma density, but decreases with pressure [1]. Therefore, a plasma source capable to generate ion density as high as possible while keeping the pressure as low as possible is desirable.

The pulsed plasma source reported in this work consists in the classical processing RF plasma in which supplementary ions, electrons and metastable atoms are injected using very short high voltage positive pulses applied on a separate electrode. In this way, for short duration of time (hundreds of microseconds) the plasma density is increased by at least one order of magnitude. Using the same repetition rate for the high voltage positive pulses as for the negative accelerating pulses applied on the target, RF plasma density was increased shortly before each ion accelerating pulse. Practically, the plasma source consists of a chamber divided in two unequal volumes by a grounded grid [2]. In the larger volume capacitive coupled RF plasma was continuously generated in argon buffer gas at low pressure (few Pa), using one RF electrode 3 cm in diameter, which was driven by a 13.56MHz RF generator. High voltage pulsed discharges are periodically generated in the smallest part of the chamber by applying very short (~100 ns) high voltage (6 kV) positive pulses on a separate electrode at a repetition rate of about 30 Hz. The negative accelerating pulses on the target electrode are synchronized with the positive pulses by coupling the pulse generators through a pulse transformer.

We evidenced the advantage of the new plasma source by nitrogen implanted tests on copper and brass samples. Also, the new plasma source was tested for metal ion implantation on non-metallic surfaces. Processed surfaces were analysed by Glow Discharge Atomic Emission Spectrometry (GD-OES) and by X-Ray Photoelectrons Spectroscopy (XPS). The results show the benefits of this new plasma source compared to the classical RF plasma.

Acknowledgements: This work is supported by UEFISCDI Grants, project: PT-PCCA-2011-3.1-1136, of the Romanian Governmental Agency of Scientific Research

[1] S. Mukherjee, *Curr. Sci.* **83**, 263.3 (2002)
[2] C. Diplasu, A. Surmeian, A. Groza, M. Ganciu, *Surf. & Coatings Techn.* **203**, 2858 (2009)