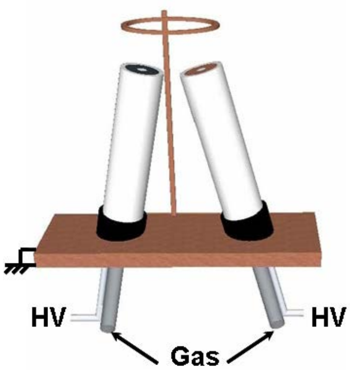
Configuration Of Two Hollow Cathodes For Creating Thin Film Alloys

B.G. Rusu[1,2], C. Rusu[1,2], R. Schrittwieser[2], C. Ionita[2], V. Tiron[1], S. Costea[2], B.S. Schneider[2], G. Popa[1]

[1]*Faculty of Physics, Alexandru Ioan Cuza University, Iasi, Romania*

[2]*Institute for Ion Physics and Applied Physics, University of Innsbruck, Innsbruck, Austria*

Thin film alloy deposition is one of the most important technological applications of plasma physics. Very important applications of thin films deposition in plasmas are for example semiconductor manufacturing and solar cell production. Various techniques are in use, like magnetron discharges, thermo-ionic vacuum arcs (TVA), laser ablation, hollow cathodes, and many more [1]. Of extraordinary importance have recently become medical applications of plasma physics depositions such as implants [2].



(a) **(b)**

Fig. 1. Hollow cathode set-up (a) and photo of the discharge (b) at $2{\cdot}10^{-1}$ mbar working pressure and 40 mA discharge current for each cathode.

The experiments were carried out in the Innsbruck Plasma Laboratory in a newly built hollow cathode discharge (HC) configuration which combines two cathodes of different materials (Ti and Cu) for obtaining thin films of Ti-Cu alloy. The primary goal of the investigations was to find the best plasma conditions (Fig. 1.). After creating a clean vacuum below 10^{-5} mbar by a turbo molecular pump we introduce Ar as working gas to the working pressure between $1{\cdot}10^{-2}$ and $1{\cdot}10^{-1}$ mbar. The discharge current was varied between 10 mA to 40 mA on both cathodes, thereby also varying the plasma density.

The electrical proprieties of the hollow cathode discharge were determined by Langmuir probes. From the probe characteristic we obtain plasma potential, floating potential and electron temperature in the mixing plasma region. With both HC in operation, the electron saturation current increases by a factor of about 7. Also the ion saturation current decreases compared to the Ti cathode discharge or Cu cathode discharge alone. The plasma potential was derived from the first derivative of the Langmuir probe characteristics. We have observed that the plasma potential of the combined Ti+Cu hollow cathode discharge is smaller by approximately 5 V than the potential in the Ti or Cu hollow cathode discharge alone.

The Ti-Cu alloy thin films will be analyzed by XPS spectroscopy (for investigation of the chemical composition and chemical structure), AFM (for information on the thin films topography), SEM (for calculating the deposition rates) and X-rd (for crystallographic characterization of the films).

[1] M.A. Lieberman, A.J. Lichtenberg, *Principles of plasma discharges and materials processing*, John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2005.

[2] N. Dumitraşcu, V. Vasilca, M. Tepelus, L. Padureanu, M. Voicu, G. Popa, *Physica Medica* **15** (1999), 187; N. Dumitraşcu, T. Bălău, M. Tască, G. Popa, *Materials Chem. Phys.* **65** (2000), 339; N. Dumitraşcu, G. Borcia, G. Popa, *J. Appl. Polymer Sci.* **81** (2001), 2419.