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Evaluation of chromium thin films produced by hollow cathode-like discharge PIII&D

Carina B. Mello[1], Rogério M. Oliveira[1] and Mario Ueda[1]

[1] *Associated Laboratory of Plasma, Instituto Nacional de Pesquisas Espaciais, Av. dos Astronautas, 1758, São José dos Campos, SP, 12227-010, Brazil*

The benefits of PIII process are extended when the implantation process is associated with the formation of thin films and it became a hybrid technique that includes implantation and deposition phases, known as plasma immersion ion implantation and deposition (PIII&D). Chemical, physical and mechanical properties of thin films, especially adhesion, stress and hardness, are changed when plasma immersion ion implantation is applied on thin films during or after their growth. PIII&D process improves the film adherence to the substrate by mixing the atoms of film and substrate on the interface between them. The process in this study associates a hollow cathode-like discharge PIII and magnetron sputtering deposition, associating the PVD process with plasma implantation. High voltage glow discharge inside the tube (working as a hollow cathode) generates high density plasma which ionizes some metal atoms coming from the metal target. The high voltage pulses are also applied in samples, which leads to implantation of Cr ions during "on" pulse and deposition during "off" pulse. The association of hollow cathode-like discharge + PIII and magnetron sputtering deposition produces thin coatings with very low defect density. For this paper, chromium thin films were deposited on carbon steel surfaces in order to evaluate the deposition process for corrosion resistant thin films. Corrosion tests on steel surface showed that chromium films produced by this method increase the corrosion potential and decrease the corrosion current density about 2 orders of magnitude, improving the corrosion resistance of the SAE 1070 carbon steel, when compared to non-coated sample. Cr films presented a columnar growth, with dome shape end and low roughness, especially for lower energy of HVGD in the tube, but the variation in PIII energy does not affect deposition rate.

Corresponding author: Carina Mello, *e-mail:* carina@plasma.inpe.br