CHROMIUM CARBIDE THIN FILMS PRODUCED BY HOLLOW CATHODE-LIKE DISCHARGE PIII&D

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1. Introduction

Chromium carbide (Cr-C) is a ceramic compound that exists in several different chemical compositions: Cr3C2, Cr7C3 and Cr23C6. It is extremely hard and corrosion resistant. It is also a refractory compound, which means that it retains its strength at high temperatures as well. Chromium carbide provides excellent corrosion resistance due to the formation of a thin, but strongly adherent, surface layer of chromium oxide which effectively prevents further oxidation of the bulk material at elevated temperatures in air [1]. It is well-known that different deposition conditions, when using deposition techniques such as magnetron sputtering, can result in Cr-C films that are amorphous, polycrystalline or composites of nanocrystalline carbide grains distributed in an amorphous carbon matrix [2]. In this work, Cr-C films were deposited by hollow cathode like discharge PIIID, a duplex process combining iMS deposition and ion implantation. The influences of processing parameters on composition and corrosion resistance of the as-deposited films were studied.

2. Experimental

The process in this study associates a hollow cathode-like discharge PIII and magnetron sputtering deposition, associating the thin film deposition process with plasma implantation (Fig. 1). High voltage glow discharge inside the tube generates high density plasma, which ionizes some metal atoms coming from the chromium 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. Graphite pieces were placed inside the tube and acted as the carbon source. Some processing parameters, as implantation energy and amount of graphite pieces were studied. Silicon and SAE 1070 carbon steel were used as substrates.

3. Results and Discussions

The association of magnetron sputtering deposition and hollow cathode-like discharge PIII produces adherent coatings with very low defect density. XRD patterns of as-deposited films showed different chemical compositions for Cr-C. Corrosion tests on steel surface showed that chromium films produced by this method increases the corrosion potential and decreases the corrosion current density, improving the corrosion resistance of the SAE 1070 carbon steel, when compared to non-coated sample. SEM, XPS and polarization curves will be shown in the conference.

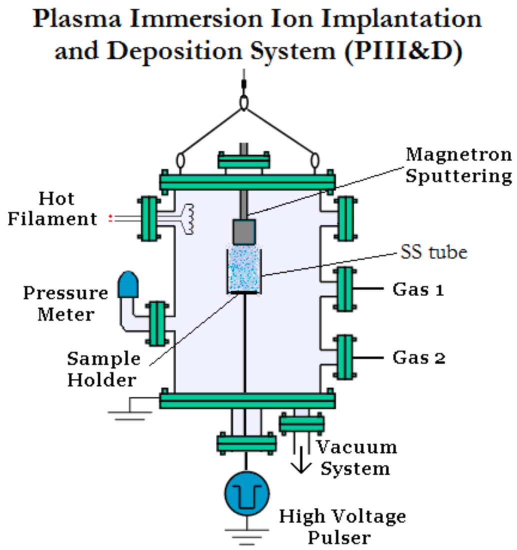

Fig. 1. *Hollow cathode-like discharge PIII&D system.*

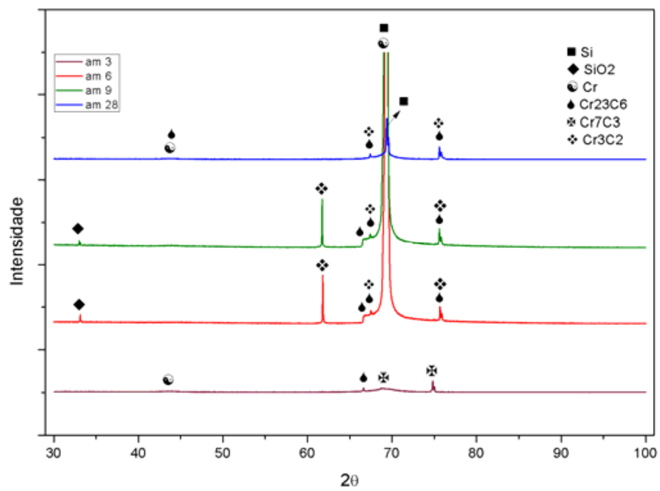

Fig. 2. *XRD patterns of Cr-C coating deposited on silicon surface.*

4. References

[1]- K. Nygren *et al.*, Applied Surface Science, **305**, 143–153, (2014).
[2]- J. Högström et al., Electrochimica Acta, **122**, 224– 233, (2014).

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