NANOCRYSTALLINE DIAMOND IMPROVED DIAMOND-LIKE CARBON ELECTROCHEMICAL CORROSION RESISTANCE

F. R. Marciano[1,2]*, E. C. Almeida[1], D. A. Lima-Oliveira[1], E. J. Corat[1] and V. J. Trava-Airoldi[1]

[1]*Instituto Nacional de Pesquisas Espaciais (INPE)*
[2]*Instituto Tecnológico de Aeronáutica (ITA)*

1. Introduction

Consisted of dense amorphous carbon or hydrocarbon, diamond-like carbon (DLC) mechanical properties fall between those of graphite and diamond with potential uses in electrochemical applications [1,2]. Some authors have reported the concern of doping DLC films with metal ions in order to combine the properties of the ions and the bulk of the host material [3]. In this paper nanocrystalline diamond (NCD) particles were incorporated into DLC films in order to investigate NCD-DLC electrochemical corrosion resistance.

2. Experimental

DLC films were growth over 316L stainless steel using plasma enhanced chemical vapor deposition. NCD particles were incorporated in layers into DLC during the deposition process. NCD-DLC films were characterized by scanning electron microscopy (SEM), X-ray diffraction, atomic force microscopy (AFM) and Raman scattering spectroscopy. Wetting contact angle, stress and micro-hardness were also evaluated. Emphasis was placed on the investigation of NCD-DLC electrochemical corrosion behavior, which was tested by potentiodynamic method.

3. Results and Discussions

Fig. 1a shows the as-deposited 10-layer-NCD-DLC microstructure. As NCD number of layers increased, NCD-DLC films become rougher (Fig. 1b) and hydrophobic. They also presented lower stress with an increase in hardness values. The corrosion potential becomes more negative and the anodic and cathodic current densities decreased with the increase of NCD density particles, as compared to the pure DLC and the substrates. These results were confirmed by Nyquist plot (Fig. 2), which shows a stronger ohmic behavior for NCD-DLC and Bode plots with different corrosion behaviors. The electrochemical analysis indicated NCD-DLC films present superior impedance, polarization resistance and breakdown potential as compared to the pure DLC, which indicate they are promising corrosion protective coating in aggressive solutions.

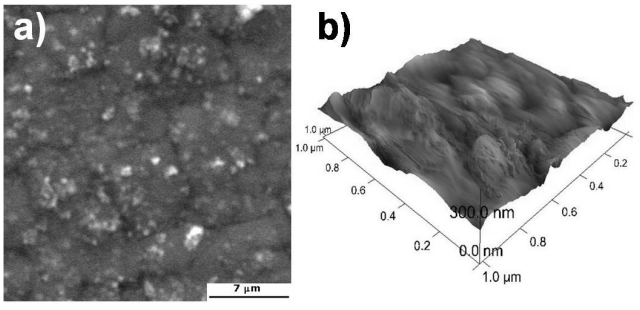

Fig. 1. *Surface morphology of a 10-layer-NCD-DLC film by* **(a)** *SEM and* **(b)** *AFM.*

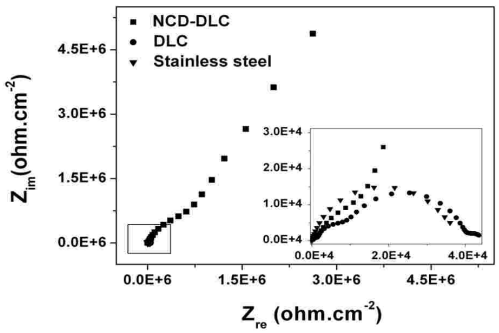

Fig. 2. *Nyquist plot of stainless steel, DLC and NCD-DLC films.*

4. References

[1]- J. Robertson, Mater. Sci. Eng., R **37**, 129-281, (2002).
[2]- E. Liu and H.W. Kwek, Thin Solid Films, **516,** 5201-5205, (2008).
[3]- F.R. Marciano, L.F. Bonetti, R.S. Pessoa, J.S. Marcuzzo, M. Massi, L.V. Santos, V.J. Trava-Airoldi, Diamond Relat. Mater., **17,** 1674-1679, (2008).

Acknowledgments

The authors are very thankful to CNPq and FAPESP for the financial support.

*Corresponding Author: fernanda@las.inpe.br