CORRELATION BETWEEN CHEMICAL CORROSION AND FRICTION COEFFICIENT OF DLCH FILMS IN SEAWATER

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1. Introduction

While many studies have focused on ways to apply diamond-like carbon (DLC) film in specifics applications, little has been published about the hydrogen content as a limiting factor. The aim was to find a correlation between the hydrogen content in DLC as protective coating in contact with seawater. In this paper was study the correlation between wettability, chemical corrosion, porosity and friction coefficient from DLC films with different hydrogen content in seawater. As expected, samples pair with high percentages of hydrogen in seawater showed lower polarization resistance and high friction coefficient. While the samples with low hydrogen content and high C-C bodings in rings presented high polarization resistance and low friction coefficient. Thus, electrochemical measurements, contact angle, optical profiler images, and Raman spectra's were use to specify the correct hydrogenation from DLC films in seawater.

2. Experimental Procedure

The DLCH films were growth on ASI304 substrate by using Plasma enhanced Chemical Vapor Deposition PE-CVD and r.f. technique. The DLCH films were deposit up to 2 µm of thickness of on polished AISI304 substrates, using pure methane as a hydrocarbon source in chemical vapor deposition (PECVD) as described early [1]. The Raman spectroscopy was performed with a Renishaw 2000 system using an Ar+-ion laser (λ=514 nm) in backscattering geometry. The hydrogen content in DLCH was analyzed according to the Casiraghi study that showed the correlation between the signature of hydrogenated samples in visible Raman increase with photoluminescence background (PL) for increase H content[2]. Electrochemical measurements were carried out with a potentiostat–galvanostat AUTOLAB system model PGSTAT 302. The corrosion potentials were near stable after immersion of the samples in the Brazilian north beach seawater for about 15 min. The potential scans were from −1.5 V to 1.5 V with a scan rate of 1 mV/s. Contact angle measurements were carried out using a Rame–Hart goniometer (Model 100-00) by the sessile drop method at 25˚C in a chamber with environmental atmosphere. Was used de-ionized water, as the polar liquid, and di-iodomethane, as nonpolar.

3. Results and Discussions

Fig. 1(a) shows polarization diagrams and 1(b) optical image from AISI304, with DLCH40%; DLCH35%, and DLCH20% in seawater after electrochemical corrosion. The results showed that: DLCH40% presented highest current density and lowest corrosion potential than DLCH30% and DLCH 20%. Was observed that DLCH 40% corrode after electrochemical tests and the opposite occurred with DLCH20%. So DLCH40% is more reactive than DLCH20% in seawater. DLCH20% presented the best chemical resistance in seawater. A correlation between Ramam spectra's, contact angle, and friction coefficient from DLC pairs in seawater will be presented.

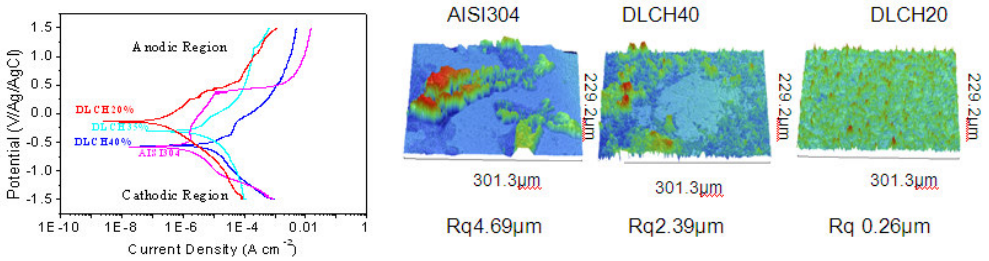

Fig.1. (a) *polarization diagrams and* **(b)** *optical image from AISI304, with DLCH40%; DLCH35%, and DLCH20% in seawater after electrochemical corrosion.*

4. References

[1]- V.J. Trava-Airoldi, L.F. Bonetti, G. Capote,L.V. Santos , E.J. Corat, *"A comparison of DLC film properties obtained by r.f. PACVD, IBAD, and enhanced pulsed-DC PACVD"* Surface & Coatings Technology, **202,** 549–554 (2007)

[2]- C. Casiraghi, A. C. Ferrari, and J. Robertson, *"Raman spectroscopy of hydrogenated amorphous carbons"* Phys. Rev. B, 72, 085401 (2005)

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