THE FRICTION COEFFICIENTS DLC FILMS ARE DEPENDENT ON THE SLIDING ENVIRONMENT AND DLC HYDROGEN CONTENT

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1. Introduction

This paper shows the initial phase of an extensive program to deposit hydrogenated, amorphous carbon-based films on space components, such as spherical bushings, hold-downs, and aerospace release mechanisms. The aim of the present study is to identify the high-quality hydrogenated films with low friction coefficients at relatively high contact pressures both in humid air, nitrogen environment, and UHV.

2. Experimental procedure

In this work very high adherent a-C:H films on Ti6Al4V polished surface has been obtained by using 13.56 Mhz RF discharge, allowing us to apply it on space device requiring sliding between parts. Low stress was obtained with growth rate as high as 2.5 µm/h. In order to get high adherence special interlayer of amorphous silicon between the a-C:H film and the substrate was used [1,2]. The adherence and the hardness were evaluated by micro scratching and micro indentation, respectively. Friction coefficient in air and ultra-high-vacuum environment was measured in several atmospheres by pi-on-disc in air, nitrogen and vacuum environment. The analyzed pair was Ti6Al4V pin and as a counter face a Ti6Al4V disc with DLC hydrogenated film. The DLC films were deposited with at 18-20% hydrogenated and it shows a low friction regime in an air atmosphere and in N_2 atmosphere. An additional characterization technique as Raman scattering spectroscopy has been also used in order to evaluate the film quality.

3. Results and Discussion

The Fig 1a) shows the evolution of the friction coefficient vs. sliding distance in air and nitrogen and Fig. 1b) shows the evolution of the friction coefficient vs. sliding distance in UHV. The hydrogenated DLC (18-20%) films there were no low friction coefficient in UHV. This kind of film could not be used in vacuum as solid lubricant. Another high hydrogenated DLC was analyzed and the friction coefficient results in three different environments will be presented.

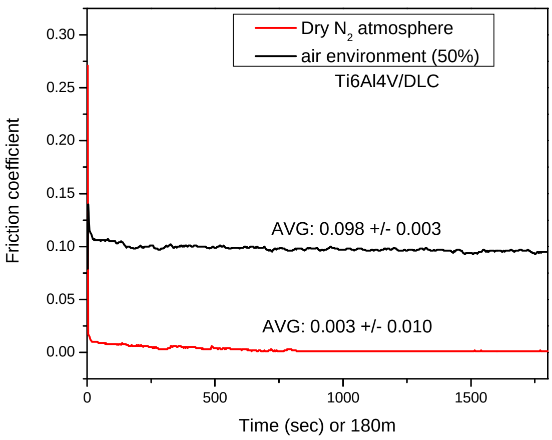

Fig. 1a) Evolution of the friction coefficient vs. sliding distance in air and nitrogen atmosphere.

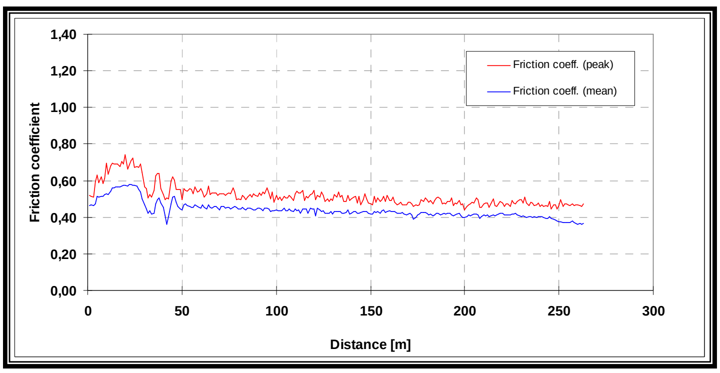

Fig. 21a) Evolution of the friction coefficient vs. sliding distance in UHV.

Figure – 1

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 RF - PACVD, IBAD, and Enhanced Pulsed - DC PACVD submitted to in Diamond Related Materials, 2006 .

[2] G. Capote, L.F. Bonetti; L.V. Santos, E.J. Corat, V.J. Trava-Airoldi, INFLUÊNCIA DA INTERCAMADA DE SILÍCIO AMORFO NA TENSÃO TOTAL E NA ADERÊNCIA DE FILMES DE DLC EM SUBSTRATOS DE Ti6Al4V, submitted to Revista Brasileira de Aplicações de Vácuo, 2006.

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