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Tribomechanical properties of doped DLC coatings deposited by HiPIMS

Jose Antonio Santiago Varela[1], I. Fernandez-Martinez[1], A. Wennberg[1], M. Monclus[2], J. Molina[2], M. Panizo-Laiz[3], JC. Sanchez Lopez[4], TC. Rojas[4], S. Goel[5], JL. Endrino[6]

[1]Nano4Energy, Madrid, Spain [2]IMDEA Materials, Getafe, Spain [3]UPM, Madrid, Spain [4]ICMSe-CSIC, Sevilla, Spain [5]Cranfield University, Cranfield, United Kingdom [6]Ikerbasque, Bilbao, Spain

jasv1906@gmail.com

Diamond-like Carbon (DLC) coatings have been recognized as one of the most valuable engineering materials for various industrial applications including manufacturing, transportation, biomedical and microelectronics. Among its many properties, DLC stands out for a good frictional behaviour combined with high surface hardness, offering an elevated protection against abrasive wear. Nevertheless, a factor limiting the widespread application of DLC coatings is their thermal stability. DLC is very temperature-sensitive since its sp3-sp2 structure undergoes a graphitization process at high temperatures that deteriorates both hardness and coefficient of friction. In order to overcome this limitation, new ways to modify DLC coatings for acceptable high temperature performance have been explored. In this work, we investigated a novel deposition technique of hard DLC coatings doped with various elements (e.g. W, Cr, Ti, Si) using HiPIMS by incorporation of positive pulses. Highly ionized plasma discharges were obtained during HiPIMS deposition. The high ion energy bombardment resulted in a higher sp3 to sp2 bond ratio. EELS and Raman spectroscopy were used to characterize the sp3 and sp2 structures in the deposited films. Nanoindentation tests revealed improved mechanical properties (hardness up to 35 GPa) in the range of 27 ºC to 450 ºC. Micropillar splitting were used to evaluate toughness of the coatings. Pin-on-disk tests were carried out both at room and high temperature. Finally, micromilling trials were carried out to assess the performance of these doped DLC coatings in micromachining of Ti6Al4V samples.

Keywords
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