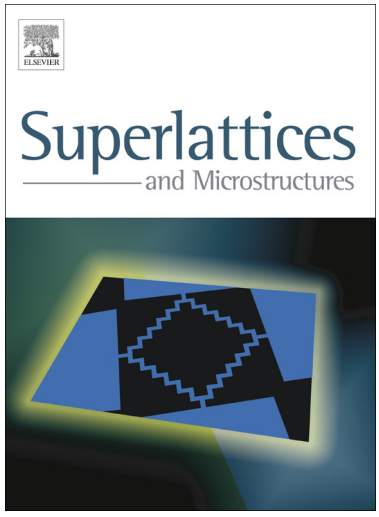

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A. Modabber Asl, P. Kameli, M. Ranjbar, H. Salamati, M. Jannesari

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Correlations between microstructure and hydrophobicity properties of pulsed laser deposited diamond-like carbon films

A. Modabber Asl, P. Kameli*, M. Ranjbar, H. Salamati, M. Jannesari

Department of Physics, Isfahan University of Technology, Isfahan, 84156-83111, Iran

Abstract

Diamond-like carbon (DLC) thin films were deposited by pulsed laser deposition (PLD) on Si-(100) substrates in the substrate temperature range of room temperature (RT) to 300 °C. The structural, hydrophobicity, mechanical, and morphological properties of the DLC films were investigated by Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), nanoindentation, water contact angle (CA) measurement, atomic force microscopy (AFM). It was found that the DLC films deposited at RT were purely amorphous in structure with high sp^3 bonding and had very smooth surfaces. Raman and XPS results indicated a structural transition from amorphous to nano-crystalline graphitic nature, structural ordering of DLC films, and decrease of the sp^3 content with increasing substrate temperature. Degradation of the surface morphology and enhancement of the surface roughness with the substrate temperature were observed by AFM. It was also found that the mechanical properties such as nanohardness, elastic modulus, plastic index parameter, and elastic recovery decreased with the increasing substrate temperature. The CA measurements indicated that the hydrophobicity of DLC films increased with the substrate temperature and was sensitive not only to sp^2/sp^3 ratio, but also to the ordering of sp^2 clusters. The observed hydrophobicity, mechanical and morphological properties were attributed to structural changes during deposition based on the sub-plantation model and stress induced mechanism.

Keywords: Diamond-like carbon, Thin films, Substrate temperature, Pulsed Laser Deposition, Hydrophobicity.

*Corresponding author. Tel: +98 3113912375, fax: +98 3113912376

E-mail: kameli@cc.iut.ac.ir