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PII: S0169-4332(13)01222-1
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2013.06.109
Reference: APSUSC 25914

To appear in: *APSUSC*

Received date: 11-4-2013
Revised date: 18-6-2013
Accepted date: 20-6-2013

Please cite this article as: M. Huang, X. Zhang, P. Ke, A. Wang, *Applied Surface Science* (2013), http://dx.doi.org/10.1016/j.apsusc.2013.06.109

Graphite-like carbon films by high power impulse magnetron sputtering

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Highlights

HiPIMS, a new deposition technique, is used to fabricate GLC films.

Effects of impulse voltage on structure and properties of the GLC films are investigated.

HiPIMS increases the formation of sp^2 bonds in the GLC films.

Increasing fraction of sp^2 is favorable for enhanced tribological properties of the GLC films.

The fraction of sp^3 is found to be relevant to hardness of the GLC films.

Abstract

High-power impulse magnetron sputtering (HiPIMS), coupled with a direct-current magnetron sputtering (dcMS) in parallel, was employed to fabricate graphite-like amorphous carbon (GLC) films. Different impulse voltages were applied in HiPIMS during the film deposition. The structure and mechanical properties of the GLC films deposited by the HiPIMS were investigated. The bonding structure of the films was analyzed by X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy. Atomic force microscopy (AFM) and Nano-indentation were used to characterize the surface quality and micro-hardness, respectively. Internal stress of the films was calculated based on the curvature measured by a laser tester. Tribological behavior of the GLC films is studied by a ball-on-disc tribometer in ambient condition. The effects of impulse voltage on deposition rate, internal stress, mechanical and tribological properties of the GLC films were investigated. The results are analyzed and discussed.

Keywords: Graphite-like carbon film; High power impulse magnetron sputtering; Microstructure; Hardness; Friction coefficient