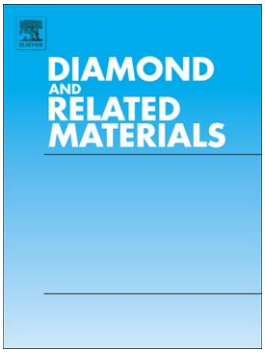

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PII: S0925-9635(15)30079-0
DOI: doi: 10.1016/j.diamond.2015.10.031
Reference: DIAMAT 6502

To appear in: *Diamond & Related Materials*

Received date: 15 July 2015
Revised date: 28 October 2015
Accepted date: 31 October 2015

Please cite this article as: Chehung Wei, Kang-Shen Peng, Min-Sheng Hung, The effect of hydrogen and acetylene mixing ratios on the surface, mechanical and biocompatible properties of diamond-like carbon films, *Diamond & Related Materials* (2015), doi: 10.1016/j.diamond.2015.10.031

The Effect of Hydrogen and Acetylene Mixing Ratios on the Surface, Mechanical and Biocompatible Properties of Diamond-Like Carbon Films

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Abstract

In this study, diamond-like carbon (DLC) films were deposited on silicon substrates using different hydrogen and acetylene mixing ratios with the same total flow rate by RF plasma-enhanced chemical vapor deposition. By altering the ratios of ion and neutral radicals, different precursor combinations resulted in different film properties. To obtain the optimal precursor combinations, the morphological, structural, hydrophilic, mechanical, and biocompatibility properties were probed by AFM, Raman spectra, contact angle measurements, nanoindentation, and ECV-304 cell cultures, respectively. The results showed that, for DLC films with high hydrogen contents, the depleted carbon gas and high hydrogen etching resulted in a lower film thickness and smoother surface morphology. In terms of the film structure, the hydrogen-rich DLC films possessed a higher I_D/I_G ratio and an upward G-peak position shift due to an increase in the sp2 grain size and bond-angle order. The high hydrogen content also led to increase in the residual stress, hardness, and the Young's modulus. The primary mechanisms for this increase were determined to be due to extensive hydrogen bombardment and the presence of covalent bonds. In biocompatibility, the cell number for ECV-304 ascended if the hydrogen precursor ratio was increased. The mechanism for this increase was characterized by protein absorption associated with hydrophilicity. The results of this research demonstrated that the DLC deposited at moderate hydrogen levels might possess the best overall film properties.