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Preparation of N-doped diamond-like carbon films by helicon wave plasma chemical vapor deposition

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Nitrogen-doped diamond-like carbon (N-DLC) films were prepared by helicon wave plasma chemical vapor deposition (HWP-CVD) method on Si substrates using $Ar/CH_4/N_2$ gas mixture at different negative DC bias. Raman spectroscopy (Raman) and scanning electron microscopy (SEM) were used to characterize the microstructure, surface and cross-section morphology of nitrogen-doped diamond-like carbon films, respectively. The wettability of the films was obtained by water contact angle analyzer. The relationship between the contact angle, diffusion, surface tension and surface energy of N-DLC films and two different liquids were introduced. Compared with the contact angle, the diffusion parameter SP is a reliable parameter for describing the wettability of lubricating oil for selected thin film materials. Raman spectra shows that the nitrogen-doped diamond-like carbon films have two peaks at about 1355 cm^{-1} and 1580 cm^{-1} corresponding to the D and G-band, respectively. XPS results identify that the carbon is bonded with nitrogen. The carbon and nitrogen in the films have been combined to form C-N, C=N and C≡N, indicating that amorphous carbon and nitrogen structures are formed in the films, while C=N bonds exist. At the same time, the SEM results show that the films surface are uniform, compact and smooth. From the cross-section, thickness of the film decreases with the increase of negative bias voltage.

Keywords: Nitrogen-doped diamond-like carbon; helicon wave plasma; Raman; SEM; XPS

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