Effect of silver doping on electrical and optical properties of diamond like carbon films

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Diamond-like carbon (DLC) film has been extensively studied due to their remarkable properties and potential applications. The ratio of sp^2/sp^3carbonatomsisoneofthemostimportantfactorsdetermining the quality of the DLC films, which can be changed by incorporating different elements into DLC matrix [1]. Various attempts have been made to dope DLC films with different elements such as boron, phosphorus, nitrogen, sulfur, silicon and tin etc. and the doping effects of these elements have been extensively investigated. Among them silver incorporated diamond like carbon (Ag:DLC) has been an interesting research field of diamond-like carbon owing to its potential for solving some of the major drawbacks of pure DLC films. Ag incorporation in the DLC films reduce surface free energy and residual internal stress without sacrificing the hardness, increase hydrophobic properties and improve hemocompatibility and antibacterial properties for biological application [2,3].

In this work we have reported the effect of silver incorporation on the optical and electron field emission properties of DLC films deposited by the RF reactive sputtering technique. The chemical binding energy and compositions of the films were investigated by X-ray photoelectron spectroscopy (XPS) studies. Optical transparency and optical band gap decreased with the silver incorporation to the DLC film. Optical band gap calculated from transmittance spectra decreased from 2.55 to 1.95 eV with a variation of Ag concentration from 0 to 12.5 at. %. The field emission measurements showed that the threshold field and effective emission barrier were reduced by silver doping and the emission current strongly depends on the silver doping percentage. The threshold field was found to decrease from 6.8 to 2.6 V/mm with a variation of Ag atomic % from 0 to 12.5. The field enhancement factor was calculated and we have explained the emission mechanism.

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