Plasmonic Diamond Like Carbon Nanocomposite Films and Nanostructures

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Abstract

Nanocomposites with embedded nanoparticles of the group IB metals such as Au, Ag, Au received a significant interest due to the presence of the surface plasmon resonance effect [1-5]. Optical properties of such plasmonic materials can be additionally controlled by changing structure and composition of the dielectric matrix of the nanocomposite.
Diamond like amorphous carbon (DLC) is very good candidate as a plasmonic nanocomposite matrix material due to the deposition at room temperature, possibility to vary electrical and optical properties of DLC in a wide range, their excellent mechanical properties such as hardness up to 80% of diamond hardness as well as corrosion resistance and biocompatibility [3-9]. Particularly refractive index of DLC can be changed in 1.6-2.5 range while keeping high optical transmittance [6-8]. DLC films containing group IB metal are growing in the form of the metal nanoparticles embedded into the DLC matrix due to the inability to form Ag (Cu, Au) carbides at room temperature [3-5].
In this study DLC nanocomposite films containing Ag nanoparticles (DLC:Ag) and DLC films with embedded Cu nanoparticles (DLC:Cu) were deposited by reactive magnetron sputtering.
It was found that maximum of the surface plasmon resonance peak of the absorbance spectra can be changed in wide range by changing chemical composition of the nanocomposite as well as size of the metal nanoclusters and nanocrystalites [4,5]. Surface enhanced Raman scattering effect was observed in DLC:Ag films. There were shown that optical properties of the nanocomposite films can be additionally controlled by nanostructuring such as formation of the nanoholes matrix in the DLC film. Photovoltaic properties of DLC:Ag and DLC:Cu nanocomposites at different excitation wavelengths were studied. Observed dependence of the open circuit voltage and short circuit current on excitation wavelength as well as their correlation with transient optical absorption spectra was considered.

References

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