SERS STUDY OF SP^2/SP^3 CARBON NANOSTRUCTURES, PRODUCED BY DUAL MAGNETRON SPUTTERING AND ION BEAM MODIFICATION TECHNIQUE

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Diamond nanostructures are considered as material for a number of applications. In bio-medical studies, nanostructured aligned 2D and 3D systems are considered for analytical applications (biosensors) and bioengineering (for modification of mechanical, adhesive, bactericidal properties of material). Problems of synthesis of structures with desired and pre-established configuration and properties and their characterization are topical.
In this study carbon nanostructures were produced by combination of dual magnetron sputtering system and ion beam modification technique. The method allows synthesis and spatial alignment of graphite shell-diamond core nanoparticles in 2D and 3D patterns. The diamond core size is about 3-5 nm. Thin Ag film forming by clusters of size about 30 nm was deposited on the carbon structure. The morphology and structure of obtained ND-Ag hybrid were observed using scanning and transmission electron microscopy (SEM, TEM), and electron energy-loss spectroscopy (EELS).
To analyze the carbon core-shell nanoparticles surface the method of surface enhanced Raman scattering (SERS) was applied. Interaction of ND surface with plasmonic metal allows detection of surface enhanced Raman scattering [2], obtaining the information about graphite fraction, and detecting local defects with sp and sp^2 hybridization on the diamond nanoparticles surface. It is of high importance for applications development as the sensing, bioengineering abilities, biocompatibility of nanostructured sp^3-containing materials are in high degree determined by the ND surface structure and chemistry. Particularly, it was shown that antibacterial properties of ND are determined by sp^2 fraction on the ND surface [1].
SERS characterization of designing nanostructured systems gives additional information for production of the carbon-Ag nanohybrid of controllable alignment and properties. Additionally, Ag nanoclusters on the ND surface allow modulation of ND luminescence [2], open ways for developing sensing applications based on Ag plasmonic properties, and for study of one-photon and two-photon luminescence of Ag-ND hybrid nanostructure at interaction between Ag and ND and of the nanohybrid with the closest environment, which involves the plasmon effects and energy transfer, etc.

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