Nanotechnology and nanooptics of films with C_{60} fullerenes

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The nanoheterostructures with C_{60} fullerenes are promising materials for electronic, sensor and biomedical applications. In this work, thin films of C_{60} on non-heated silicon substrates with different surface morphology (smooth and microrelief) were investigated. The microrelief surfaces were prepared by anisotropic chemical etching of crystalline silicon wafers (100). The films were obtained by thermal sublimation of C_{60} fullerene powder in vacuum. The composition, structure, optical properties, and the inner mechanical stresses of the films were studied by micro-Raman and photoluminescence spectroscopy, and by curvature measurements from the heterostructure bending.

Molecules C_{60} under ambient conditions form near-ideal molecular crystals with molecules bound together by the van der Waals interactions. New carbon structures in the films have been obtained from fullerene C_{60} by using different deposition condition [1] and outside influence [2]. In this work, the appearance of graphite-like phase in the films by decomposition of fullerenes in the deposition process was observed. We found a strong effect of the film morphology and film composition on the Raman and photoluminescence spectra and on mechanical stresses level. Raman spectra of films with C_{60} fullerenes in the high-frequency range revealed very intensive Raman lines at 1425, 1470 and 1575 cm^{-1}, related to vibrational modes of C_{60} molecules. Additional broad phonon band at 1600 cm^{-1} appeared in the Raman spectra of composite films with graphite-like structure evidence the decomposition of C_{60} fullerenes in the deposition process. The photoluminescence of films with fullerene was registered the infrared range, and photoluminescence signal appeared in the visible range spectra for films with composite structure. It was established, that composite films on smooth substrate, and films on microrelief substrate contain smaller level of mechanical stresses.

1. P.L. Neluba P.L. Peculiarities of C_{60} fullerenes condensation from molecular beam in vacuum // Technology and construction in electronic equipment - 2011. - № 6. – P. 35 – 39.
2. Kolyadina E.Yu., Matveeva L.A., Neluba. P.L., Shlapatskaya V.V. Physical properties of C_{60} fullerene nanostructures // *Materials Science and Engineering Technology*. – 2013. - № 2/3. – P. 144 – 149.