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# Hybrid Structures of $a$-C:H Films Covered with Ag Nanoparticles for Application in Photonics*

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In this paper, the optical density and photoluminescence (PL) spectra of thin-film hybrid structures based on amorphous hydrogenated carbon ($a$-C:H) with a wide (2.7 eV) and narrow (0.4 eV) optical gap covered with granulated silver films were studied. The main goal was to study the impact of nanostructures morphology and the thickness of granulated silver films on these hybrid structures spectra. Ag films of 2 nm, 4 nm, and 10 nm gravimetric thicknesses were deposited by thermal evaporation on $a$-C:H film surfaces previously prepared by direct current CVD. With increasing Ag film thickness, the main dipole band intensity was enhanced, and the quadrupole mode band appeared in the optical density spectra of the hybrid structures. The influence of Ag NP sizes on the quenching and enhancement of photoluminescence intensity of $a$-C:H films with the different optical gap was shown. Exciton-plasmon interactions in the structures with the Ag film of 10 nm thickness led to the PL intensity enhancement of the wide- and narrow-gap $a$-C:H films to 2 and 19 times at a wavelength of 488 nm. Nevertheless, the PL intensity of the narrow-gap film remained lower as compared to a wide-gap $a$-C:H film. The impact of a cross-section amplification and the Purcell effect on the PL enhancement of $a$-C:H in the thin-film structures as a result of localized surface plasmon resonance excitation in Ag nanoparticles are discussed.

**Keywords:** silver nanoparticles, morphology nanostructure, amorphous hydrogenated carbon, optical density spectra, exciton-plasmon interactions, photoluminescence.

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