Optical properties of diamond-like carbon films modified with silver and platinum

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In this work comparative results of amorphous diamond-like carbon films with silver (a-C:H<Ag> films) and platinum (a-C:H<Pt> films) clusters structure and optical properties study are presented. The films were fabricated by ion-plasma magnetron sputtering of combined polycrystalline graphite-metal target. The sputtering process was carried out in hydrogen and argon gas mixture. The films were deposited on quartz and silicon substrates. The content of platinum and silver impurity in the films was changed from 0 to 9 at. % and from 0 to 20 at. %, respectively. Concentrations of metal in the films were changed by alteration metal and graphite area relation in the combined target.

Presence of isolated clusters in the films was found by transmission electron microscopy (TEM). The diameter of Pt clusters weakly changed with a rise of a metal content and was ~5 nm. On the contrary, the average size of the Ag clusters grows from 2 nm at 2 at. % to 8 nm with a metal content increase to 20 at. %.

An important feature of a-C:H<Pt> and a-C:H<Ag> films optical properties was the presence of absorption peak in the visible range of the optical absorption spectra. The absorption peaks in spectra of the a-C:H<Pt> films situated in the range from 495 to 498 nm and for the a-C:H<Ag> films lied at 420 nm. The intensity of the peaks rose with increase of metals concentration in the films. Besides, the peaks were more intensive in a-C:H<Ag> films in comparison to the a-C:H<Pt> films at the same metal concentration. It is supposed that the absorption peaks in both cases are the result of surface plasmon resonance on metal clusters in the films. Size of clusters was determined from resonance absorption spectra and it was in good agreement with TEM results.

Modeling of the resonance absorption process with a usage of Mie theory for the isolated metal clusters imbedded in the dielectric matrix provides good coincidence with our experiment.

Thus, a-C:H<Pt> and a-C:H<Ag> films are nanostructure heterophased material characterized by presence of absorption peak in the visible range of optical absorption spectrum.

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