

Nanocomposites and nanomaterials

Synthetic opals with SERS - active metals: the obtaining and characterization

M.P. Dergachov, V.N. Moiseyenko, N.A. Kutseva, D.V. Kolisnyk, H.F. Sapayev

*Physics, Electronics and Computer Systems Department, Oles Honchar
Dnipropetrovsk National University. Prospect Gagarina, 72, Dnipropetrovsk-
49010, Ukraine.*

E-mail: dergachov-mp@yandex.ru

The regular dielectric structures with inclusions of SERS – active metals are prospective materials for nanoplasmonics devices and optical sensors. Such systems can be realized on the base of synthetic opals made of the hexagonally close-packed SiO₂ globules by filling the opal pores with the chosen substance. An average size of the opal pores is varied from 40 to 110 nm at the average globule diameter of 260 nm.

This work is devoted to the making and investigating of synthetic opals with the copper and silver nanoparticles embedded by the electrochemical deposition method.

The forming of metal inclusions into opal pores was controlled by the X-ray diffraction of Cu-K_α radiation. The changes in the effective dielectric permittivity were detected by studying the optical reflection spectra in the visible spectral region.

The existence of the copper together with a small fraction of copper oxide Cu₂O was detected in some samples which were undergone the electrochemical deposition in a water-CuSO₄ solution. Further heating of the samples up to 800 °C resulted in the total forming of CuO. The ‘red’ shift of the optical Bragg reflection peak was more than 50 nm, in this case.

No traces of the other components were observed in the samples which were undergone the silver electrochemical deposition. The additional optical resonances were observed in the reflection spectra of opals with the silver inclusions. The reason for them was the forming of different silver clusters whose sizes were about of sizes of the opal pores.