

Nanocomposites and nanomaterials

Nanocrystallization of active dielectrics into pores of synthetic opals

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The creation of regular structure of dielectric nanocrystals in transparent matrix is of a significant interest for solid state physics of low-dimensional systems and nonlinear optics [1, 2]. One of the ways of producing such structures is the growth of the nanocrystals in pores of synthetic opals. Forming of the solid phase from the melt is under extreme conditions in this case. It may result in obtaining new phases if the embedded dielectric is polymorph.

The phase composition and optical properties of opals with the embedded nanocrystals of active dielectrics ($\text{Bi}_{12}\text{SiO}_{20}$ (BSO), $\text{Bi}_{12}\text{GeO}_{20}$ (BGO), $\text{Li}_2\text{B}_4\text{O}_7$ (LB4), $\text{Pb}_5\text{Ge}_3\text{O}_{11}$, and TeO_2) are investigated by using the X-ray diffraction of Cu-K_α radiation, the optical reflection in the visible spectral region and Raman spectroscopy method.

The obtained results are the following:

- 1) All embedded substances, except for LB4, are in crystalline state;
- 2) The shift of Raman bands in the opal- $\text{Pb}_5\text{Ge}_3\text{O}_{11}$, opal-BSO, and opal-BGO spectra is most probably caused by the changes in the lattice parameters of the nanocrystals that are proved by the X-ray diffraction data;
- 3) The changes seen in the Raman spectra of the opal- TeO_2 system are caused by crystallization of a metastable phase of $\gamma\text{-TeO}_2$ in the opal pores;
- 4) The decomposition of LB4 during the melting-in procedure and the crystalline -quartz phase formation is established for opal-LB4 system. The mechanism of the -quartz phase formation due to the local heating of opal matrix which is caused by exothermic lithium-oxygen reaction is proposed.

1. *Stroscio M., Dutta M.* Phonons in nanostructures // New York: Cambridge University Press.-2001.-320 p.

2. *Nasr M., Carrasco S., Saleh B., Sergienko A., Teich M., Torres J., Torner L., Hum D., Fejer M.* Ultrabroadband bigphotons generated via chirped quasi-phase-matched optical parametric down-conversion // Phys. Rev. Lett.-2008.-100.-P. 1-4.