Nanocomposites and nanomaterials

Raman characterization of nanocrystalline phase $Pb_3(PO_4)_2$ in the pores of synthetic opals

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The work is devoted to creating and Raman characterization of new nanostructured materials based on synthetic opals and ferroelastic crystal $Pb_3(PO_4)_2$ [1]. Filling the pores of opal samples was carried out by impregnating the melt of the single crystal $Pb_3(PO_4)_2$ at $T_m = 1014\ ^0C$ under the influence of capillary forces. The fact of incorporation of the lead orthophosphate into the opal pores was inferred from the shift of the maximum of the Bragg reflection band to longer wavelengths due to the increase in ε_{eff}. The degree of filling of the pores of opal with $Pb_3(PO_4)_2$, calculated from the shift of the maximum value λ_m reflection peak using Bragg's law was ~ 50 vol. %. For additional checking of the substance in the pores of the opal, we measured infrared transmittance spectra from 400 cm^{-1} to 1500 cm^{-1}. Typical absorption bands of the of the opal matrix at frequencies 487 cm^{-1}, 526 cm^{-1}, 621 cm^{-1}, 786 cm^{-1}, 981 cm^{-1}, 1056 cm^{-1}, 1089 cm^{-1} and weak $Pb_3(PO_4)_2$ band at 850 cm^{-1} were observed.

The measured Raman spectra enabled identification of the substance in the pores of opal and set its crystalline state. The decomposition of Raman bands into spectral components was carried out. Changes in the Raman spectra of nanocomposite opal - $Pb_3(PO_4)_2$ compared with the spectra of the lead orthophosphate single crystals demonstrate an increase of frequency external mode 155 → 160 cm^{-1}, 195 → 210 cm^{-1} and decrease of frequency internal modes 350 → 341 cm^{-1}, 935 → 926 cm^{-1}. It can be caused by a change in the bond lengths Pb – O and P - O after nano crystallization in the pores of the opal.

1. *Kwang-Sei Lee, Sung-Hwan Eom, Y. S. Yu.* Raman-Scattering Study of Ferroelastic $Pb_3(PO_4)_2$ at High Pressures // Journal of the Korean Physical Society-2005.-Vol. 46, No. 1.-P.315-318.