Nanocomposites and nanomaterials

The Nature of PbI_2 Films Photoluminescence

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Earlier [1,2] we have shown the perspectivity of $Pb_{1-X}Cd_XI_2$ layered semiconductors that can be suitable for elaboration of the scintillation sensors for X- and γ- rays. The unique photo- and radio-luminescent (FL and RL) properties, that is intense FL and RL of these crystals at room temperature, are related to the natural formation of PbI_2 nanoparticles (NPs) in the CdI_2 matrix during the formation of the solid solution. The presence of such nanoparticles causes the imposition of the quantum size effect on the number of quasiparticles as well as the appearance of new (surface and bulk) energy levels, which are characterized by radiative recombination at room temperature.

The aim of this work is to obtain a film with high concentration of PbI_2 NP with controlled size distribution. Such films will have optical properties similar to those of bulk crystals eliminating a bunch of negative moments such as the complexity of the technology and the consequent high cost. In present work such films were prepared from PbI_2 solution in polyvinyl alcohol (PVA) and absolute N,N-Dimethylformamide (DMF).

The investigation of the surface structure using an atomic force microscope showed the presence of PbI_2 nanoparticles with sizes ranging from10 nm to 60 nm.

The investigation of the PL spectrum at low (4.2 K) temperature and its temperature dependence (up to 100 K) allowed us to determine its energy structure and the temperature dependence of the integrated intensity, the energy position and the half-width of its components.

The detailed theoretical analysis of the obtained data using mathematical methods allowed us to reveal the nature of the optical transitions and construct a diagram of energy levels associated with the emission of these layered semiconductor solid solutions.

1. *A.P. Bukivskii, Yu.P. Gnatenko, Yu.P. Piryatinskii, R.V. Gamernyk* // Journal of Luminescence. – 2017. – v. 185. – p. 83 – 91.
2. *A.P. Bukivskii, A.O. Sofiienko, V.Ya. Degoda, R.V. Gamernyk, Yu.P. Gnatenko* // Materials Science in Semiconductor Processing – 2017 – V. 67. – p. 28 – 32.