THE EFFECT OF AU NANOPARTICLES ADDITION ON THE LUMINESCENT PROPERTIES OF BaI₂:Eu FINE POWDERS

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Nowadays scintillation materials are widely used in a variety of practical applications such as energy physics, nuclear physics, medicine, national security, exploration and etc. Iodides of alkaline earth elements, activated with Eu²⁺ ions, are attractive compounds for use as scintillation materials (they have high light output (up to 120000 photons/MeV) and energy resolution (up to 3% at 662 keV)). In this area the most promising is BaI₂:Eu²⁺ that has high $Z_d$, is not radioactive and has the smallest band gap among the halides of alkaline earth elements [1,2].

From literature it is known that doping of materials with metal nanoparticles allows to influence significantly on their optical, electrical and mechanical properties. For instance, injection of Au nanoparticles in TiO₂ allowed to detect an anodic photocurrent generated by visible-light illumination (TiO₂ has the wide bandgap (3.3 eV) and is able to generate photocurrents only when illuminated with ultraviolet light). Injection of indium tin oxide and Au nanoantennas in CaF₂ allowed to use this material for surface-enhanced infrared spectroscopy [3,4]. In accordance with the foregoing, the effect of Au nanoparticles addition on luminescent, structural and morphological properties of BaI₂:Eu²⁺ powders has been studied. As BaI₂:Eu²⁺ powders synthesis method the approach described in [5] has been used. The Au nanoparticles in the amount of 0.1 at. % were added to the precursor (BaCO₃:Eu³⁺) on the first stage of synthesis.

On X-ray diffraction patterns for BaI₂:Eu²⁺ samples with Au nanoparticles addition intensive reflexes of BaI₂ hydrates phases and low-intensive reflexes of AuI phase [Powder Diffraction File № 15–0521] have been observed. Formation of AuI can be explained by reaction of Au nanoparticles with iodine, which is released on the second stage of the synthesis. According to luminescence data one can observe that luminescence intensity of BaI₂:Eu²⁺ sample without Au nanoparticles addition is higher than that of BaI₂:Eu²⁺ sample with Au nanoparticles addition. Moreover luminescence intensity of BaI₂:Eu²⁺ sample without Au nanoparticles addition increases in first days and then gradually decreases throughout 2 weeks, while luminescence intensity of BaI₂:Eu²⁺ sample with Au nanoparticles addition increases in first days and then saves its value throughout 2 weeks. This effect is probably connected with low solubility and photostability of AuI, what perhaps prevents destruction of BaI₂.