

Preparation and Luminescence Properties of BiPO₄-PrPO₄ Solid Solutions

V.P. Chornii¹, S.G. Nedilko¹, K.V. Terebilenko¹, M.S. Slobodyanik¹, V. Boyko²

¹Taras Shevchenko National University of Kyiv, 64/13 Volodymyrska Str., 01601 Kyiv, Ukraine

²National University of Life and Environmental Sciences of Ukraine,
5 Geroiv Oborony Str., 03041 Kyiv, Ukraine

Currently the new lighting and display devices such as light-emitting diodes (LEDs), plasma display panels (PDPs), and field emission displays (FEDs) have been proposed or developed in industry, which result in great interest in searching novel phosphors for mentioned applications [1–2]. Pr³⁺ doped oxide materials including phosphates, aluminates or borates have been widely used as a red emitting phosphor exhibiting relatively strong absorption in the near ultraviolet range of the light and intense red luminescent emission of good color purity [3].

The BiPO₄ represents phosphates of simple monoclinic structure containing bismuth (III) in BiO₈ distorted environment. Therefore, based on the effective ionic radii and charge balance of cations, the activator Pr³⁺ ion is expected to occupy randomly the Bi³⁺ sites in the orthophosphate host [3].

A series of the Bi_{1-x}Pr_xPO₄ (x = 0.01 - 0.06) compounds was synthesized by a high temperature solid state reaction method. The initial materials, Bi₂O₃ (99.99%), (NH₄)₂HPO₄ (99.999%) and Pr₆O₁₁ (99.999%) were weighted in stoichiometry, then thoroughly mixed and milled in agate mortar for more than 30 min till they are uniformly distributed. The obtained mixtures have been heated at 450, 500 and 600°C for 6 h at each temperature with intermediate regrinding in porcelain crucibles along with an atmosphere agent, and then have been naturally cooled to room temperature. In order to measure the characteristics of the phosphor, the samples were grinded into powder.

The phase composition of prepared samples was determined by X-ray diffraction and IR spectroscopy methods. The solid solutions formation in limited range was found for the praseodymium series due to the significant difference in crystal structures of BiPO₄ and PrPO₄. Therefore, at high praseodymium content (more than 5 %) the mixtures of two phosphates are found on the diffraction patterns.

The luminescence properties of a Bi_{1-x}Pr_xPO₄ series were studied. It was found that the samples reveal intensive red luminescence when are excited in the range of the ³H₄→³P_J *f-f* transitions in Pr³⁺ ions. The most intensive peaks in photoluminescence spectra are related with ³P₀→³H₆ (602.8 nm) and ³P₁, ¹I₆→³F₂ (610 - 635 nm) radiation transitions in the Pr³⁺ ions.

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