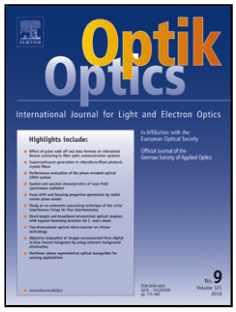

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Photoluminescence of Bi_2O_3-SiO_2 Glasses and Glass ceramics

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Abstract: Bi_2O_3-SiO_2 glasses and glass ceramics were prepared by melting method and annealing treatment. NIR emission spectra, excitation spectra and fluorescence decay curves were measured. The main NIR luminescent peak and the FWHM of the NIR luminescent between Bi_2O_3-SiO_2 glasses and glass ceramics are different. NIR luminescence peak at 1336 (1300) nm with FWHM about 200 nm is observed in Bi_2O_3-SiO_2 glasses samples, while the main luminescent peak in Bi_2O_3-SiO_2 glass ceramics locates at about 1069 nm with narrow FWHM. These two emission peaks have different excitation bands and lifetimes. We propose that NIR emissions located at 1069 nm and 1336 (1300) nm derive from Bi^{2+} and low valence Bi ions, respectively.

Key words: near infrared emission; Bi ions; glass; glass ceramics

1. Introduction

Since the discovery of ultra broadband near infrared (NIR) luminescence from Bi-doped glasses by Fujimoto et al [1], Bi-doped materials have received great interest at home and abroad [2-32]. Fujimoto suggested that Bi-doped materials could be applied as a gain medium of fiber amplifies, which has the potential to amplify signals of multi-channel communication. Lasers have been successfully excited in bismuth-doped glass fibers [33-35]. However, the nature of the active center emitting in NIR is still unclear, although numerous reference have reported the photoluminescence in various kinds of materials, such as glasses, fibers, crystals, zeolites, molecular crystals and so on. In the previous publications, the emission has been attributed to electronic transition of Bi^{5+}, Bi^{2+}, Bi^{+}, Bi clusters Bi^{-}_2 and Bi^{2-}_2 dimmer, Bi atom or color centers, but the origin is still controversial.

In this paper, we reported the NIR luminescent properties in bismuth silicate binary system. To our knowledge, bismuth is introduced as dopant of a small amount less than 5 mol% in most Bi-doped materials. Up to now, only Bi_2O_3-B_2O_3 [28] and Bi_2O_3-GeO_2 [29-32] binary systems have been studied. In Bi_2O_3-SiO_2 binary system, Bi_2O_3 is introduces as both one of the matrix members and active center. The concentration of Bi_2O_3 here is as high as 70 mol%. Besides, binary system has simple contents, it will contribute to uncover the veil of NIR luminescence active centers. Moreover, bismuth-silicate materials have a lot of industrial and special applications due to its low cost, excellent physical and chemical stabilities. And Bi_2O_3-SiO_2 binary system materials are easy to be drawn into fibres.