Molten Salt Synthesis and Luminescent Properties of Europium-Doped NiNb$_2$O$_6$ Columbites

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Pure and rare earth doped columbite-type transition metal niobates have attracted great interest in terms of their electro-optical properties during the past decade [1]. Two types of emission has been investigated as a pure and rare earth activated emission for the columbite niobates. Columbite NiNb$_2$O$_6$ ceramics has a potential application as photocatalyst for water splitting and prospective use for efficient H$_2$ production from photocatalytically under visible light irradiation [2]. Pure and rare earth doped NiNb$_2$O$_6$ powders have been synthesized by the molten salt synthesis (MSS) method which is one of the simplest, most versatile, and cheap methods available for obtaining crystalline single phase powders at lower calcination temperatures and often shorter dwell times with little impurities as compared with conventional mixed oxides, co-precipitation and sol-gel methods.

In MSS method, stoichiometric amounts of metal oxides or salts are mixed with salt or salt mixture as a reaction media which are appropriate for a given material. The synthesis of the columbite phase can be conducted above the melting point of the selected salt or salt mixture within a very short time. After cooling, salt (s) is easily eliminated by washing with deionized water [3].

Therefore, the main purpose of our study was to synthesize pure columbite NiNb$_2$O$_6$ oxides via molten salt method by optimizing the proper calcination temperature. Second stage of our study was related to synthesize the Eu$^{3+}$-doped NiNb$_2$O$_6$ powders via molten salt route by using the optimized heat treatment temperature as determined before. Structural characterization of pure and doped samples performed by using XRD, DTA-TG and SEM analysis. In the last stage of our study, we aimed to determine luminescent properties of doped and undoped NiNb$_2$O$_6$ powders by using fluorometric method.

To the best of our knowledge, we achieved to synthesize pure and Eu$^{3+}$-doped NiNb$_2$O$_6$ columbite oxides which have two principal bands in the 4f emission spectrum, namely, the yellow band near 590 nm due to the 5D$_0$→7F$_1$ transition and the red emission band around 615 nm due to the 5D$_0$→7F$_2$ transition by using molten salt method for the first time. The structural and the luminescent properties of pure and Eu$^{3+}$-doped NiNb$_2$O$_6$ columbite oxides has been investigated and discussed in detail.

REFERENCES