Thesis:

Glasses emitting white light

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Abstract:

Inorganic glass systems doped with rare earth ions are a very large group of materials which due to their properties can be used to generate white light. Much research provides a spotlight on the correlation between the spectroscopic properties and white luminescence. In many cases, the white light emission significantly depends on the glass host, concentration of rare earth ions or excitation wavelengths. It is worth noting that nowadays, many different studies based on glasses doped with lanthanide ions are focused on finding the best matrices as potential white light emitters. Additionally, the possibility of energy transfer between optically active dopant supports the generation of white light emission in inorganic glasses.

Among inorganic glass host matrices, systems doped with trivalent dysprosium ions can be potential candidates for white light generation application. The most attractive properties of glasses doped with Dy^{3+} ions result from intense emission at blue ($^4F_{9/2} \rightarrow {}^6H_{15/2}$) and yellow ($^4F_{9/2} \rightarrow {}^6H_{13/2}$) regions. The ratio of integrated emission intensity of the $^4F_{9/2} \rightarrow {}^6H_{13/2}$ transition to the $^4F_{9/2} \rightarrow {}^6H_{15/2}$ transition is known as Y/B and at a suitable Y/B intensity ratio, Dy^{3+} ions will generate white light. White luminescence properties can be changed by varying the glass systems, their chemical composition and dysprosium ions concentration.

This doctoral dissertation presents systematic results from borate glasses to germanate glasses singly, doubly and triply doped with Dy^{3+} and Ln^{3+} (Ln = Ce, Pr, Tm, Tb, Eu, Sm) ions as potential candidates to generate white luminescence. All samples were synthesized using the traditional melt quenching-technique. To study the spectroscopic properties of these glass systems, the excitation and luminescence spectra were recorded. The energy transfer processes between of rare earth ions were also examined. Moreover, the influence of concentration of rare earth ions, oxide and fluoride modifiers and excitation wavelengths on spectroscopic properties of glasses was studied. In particular, the correlation between the glass host and the yellow-to-blue luminescence intensity ratio Y/B were examined. Moreover, from the emission spectra the Commission Internationale de I'Eclairage (CIE) chromaticity coordinates (x, y) and the correlated color temperatures (CCT) were calculated in relation to the potential application of prepared glasses for white lighting. The obtained results indicate that these glasses can be used as potential white light emitters.