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Structure and spectroscopic properties of Tb^{3+}/Sm^{3+} co-doped oxyfluoride glass ceramics containing $LiYF_4$ nanocrystals

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Abstract

In this paper, transparent oxyfluoride glass ceramics containing $LiYF_4$ nanocrystals were successfully synthesized by appropriate heat-treatment on the SiO_2-Al_2O_3-YF_3-LiF precursor glass. The average diameter of the $LiYF_4$ nanocrystals is about 16 nm, which has been confirmed by XRD and TEM characterization. Compared with RE^{3+} (RE=Tb, Sm)-doped glasses, glass ceramics have shown stronger emission intensities due to most rare earth ions have entered $LiYF_4$ nanocrystals with lower phonon energy. A combination of blue, green and orange-red emissions has emerged in Tb^{3+}/Sm^{3+} co-doped glass ceramics, and white light emission could be realized by varying the proportions of Tb^{3+} and Sm^{3+} under UV light excitation. Furthermore, the concentration quenching effect and the $Tb^{3+}\rightarrow Sm^{3+}$ energy transfer process were investigated in this paper. Our results indicate that the Tb^{3+}/Sm^{3+} co-doped oxyfluoride glass-ceramics containing $LiYF_4$ nanocrystals show great potential to achieve a white light emission.

Keywords:

Glass ceramics, $LiYF_4$, Luminescence, Energy transfer

1. Introduction

Currently, researchers have shown an increased interest in achieving a white-light emission from rare earth ions doped solid-state materials. The typical way to obtain white luminescence is based on the combination of the YAG: Ce yellow phosphor with a blue LED chip [1]. However, this method exhibits a poor color rending index and a high correlated color temperature due to the absence of the red component [2].