Highly stable green and red up-conversion of $LiYF_4:Yb^{3+},Ho^{3+}$ for potential application in fluorescent labeling.

Autorzy

Weichang Li

Jixi Xu

Qiang He

Yan Sun

Shiyu Sun

Wei Chen

Małgorzata Guzik

Georges Boulon

Lili Hu

Rok wydania

2020

Czasopismo

Journal of Alloys and Compounds

Numer woluminu

845

Strony

155820/1-155820/10

DOI

10.1016/j.jallcom.2020.155820

Kolekcja

Naukowa

Język

Angielski

Streszczenie

The development of novel phosphors with stable and efficient green and red up-conversion (UC) emission is important for many applications such as fluorescent labeling, color display and anticounterfeiting. In this work, we report a stable and efficient green and red up-converter of $LiYF_4:Yb^{3+},Ho^{3+}$ octahedrons obtained by modified hydrothermal method. The UC emission and luminescence decays of $LiYF_4:Yb^{3+},Ho^{3+}$ with various Yb^{3+} and Ho^{3+} ion concentrations were studied systematically under 976 nm LD excitation. The Yb^{3+} and Ho^{3+} ion concentrations were optimized to be 20 mol% and 1 mol% respectively, for efficient green and red UC emissions. $LiYF_4:Yb^{3+},Ho^{3+}$ presents not only controlled morphology of monodisperse octahedrons with length of ~20 μm and width of ~10 μm, but also performs efficient green and red UC emissions, which is about four times stronger than that of β-$NaGdF_4$: 20 Yb^{3+},0.5Ho^{3+} ($NaGdF_4$: 20 Yb^{3+},0.5Ho^{3+}). More importantly, the stable UC emission with variation of green intensity ratio ΔG% ($G\% = I_{520\text{-}570nm}/I_{500\text{-}700nm}$, $\Delta G\% = (G\%)_{max}-(G\%)_{min}$) and red intensity ratio ΔR% ($R\% = I_{625\text{-}685nm}/I_{500\text{-}700nm}$, $\Delta R\% = (R\%)_{max}-(R\%)_{min}$) < 1% was found over 976 nm LD excitation power density (PD) ranging from 1.0 to 5.6 W/cm^2. Whereas, their variations of ~6% and 25% are observed at the same excitation PD for $NaGdF_4$:20 Yb^{3+},0.5Ho^{3+} and commercial β-$NaYF_4$:20 Yb^{3+},2Er^{3+} ($NaYF_4$: 20 Yb^{3+},2Er^{3+}), respectively. The mechanism of green and red UC emissions in $LiYF_4$: Yb^{3+},Ho^{3+} as a consequence of energy transfer processes has been briefly discussed taking into account the UC emission kinetics. The highly stable intensity ratio of G% and R% combined with the efficient green UC color hints the potential application of $LiYF_4$: Yb^{3+},Ho^{3+} in fluorescent labeling and color display.