The effect of temperature on green and red upconversion emissions of $LiYF_4$:20Yb^{3+}, 1Ho^{3+} and its application for temperature sensing.

Autorzy

Weichang Li

Lili Hu

Wei Chen

Shiyu Sun

Małgorzata Guzik

Georges Boulon

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Optical thermometry is a non-contact temperature detective technique that has high sensitivity and rapid response. In present work, we developed $LiYF_4$:20Yb^{3+}, 1Ho^{3+} (mol%) micro octahedrons obtained by a modified hydrothermal method. The temperature dependent up-conversion (UC) emission and luminescence decays for $LiYF_4$:20Yb^{3+}, 1Ho^{3+} under 976 nm LD excitation with various power density were studied systematically in the temperature range from 100 K to 500 K. The green and red UC emissions are sensitive to the sample temperature whereas the excitation power density in the studied temperature ranges plays a negligible role on the red to green UC emissions ratio. The non-contact optical temperature sensing behaviors were investigated based on the fluorescence intensity ratio (FIR) of red (R3 + R4) and green (G3) at temperature from 100 K to 500 K, which are ascribed to non-thermally coupled levels of Ho^{3+}:$^5F_5$ and $^5F_4$, respectively. The maximum absolute sensitivity (S_a) of 0.0477 K^{-1} and maximum relative sensitivity (S_r) of 0.0129 K^{-1} at the temperature range of 100–500 K based on FIR of (R3 + R4)/G3 were found. The mechanism of temperature effect on UC emission was discussed. The heating and cooling cycle test indicates the high thermal stability of $LiYF_4$:20Yb^{3+}, 1Ho^{3+}. These results imply the $LiYF_4$:20Yb, 1Ho has potential application in ratiometric thermometers and temperature sensing devices.

Słowa kluczowe

LiYF4:Yb3+ , Ho3+ micro-crystal, temperature sensing, Fluorescence intensity ratio

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