Co-doping to extend the operating range of luminescence thermometers. The case of $Y_2SiO_5:Pr^{3+},Tb^{3+}$

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The employment of phosphors in luminescence thermometry is deemed one of the pivotal developments in the field. Besides the convenience of remote readings, phosphors may offer a plethora of other alluring benefits in this field. At present, one of the most paramount predicaments in this field involves developing an optical thermometer capable of functioning across an extensive temperature range encompassing hundreds of degrees while simultaneously delivering reasonable thermal sensitivity. As recently proven by us, the range of temperature readout can be significantly enhanced by the combination of intra- and interconfigurational transitions of Pr^{3+} while maintaining S_r> 0.5 %/K across the whole temperature range. In this work, the idea has been extended using the combination of two dopants, Pr^{3+} and Tb^{3+}, which exhibit minimal interference and instead demonstrate a combined impact of their respective temperature-dependent attributes across a range of almost 850 degrees (17–888 K) with relative thermal sensitivity up to 3.5 %/K at 405 K. Additionally, an impressive value of S_r = 1.17 %/K at elevated temperature (738 K) was obtained. Temperature sensing was possible by utilizing both Pr^{3+} and Tb^{3+} emissions, showing different thermal quenching properties. That was key for broadening the temperature operating range compared to the singly-doped $Y_2SiO_5:Pr^{3+}$ phosphors.

Słowa kluczowe

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