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Synthesis and characterisation of thermographic phosphors with sub-K sensitivity

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Introduction

Thermographic phosphors are an essential medium for temperature measurement. They have found applications in temperature measurements in very low and high-temperature environments such as biological systems (Fig. 1(e)) [1], convention (Fig. 1(f)) and combustion systems. Phosphor thermometry utilizes temperature-sensitive powders which usually consist of host materials which could be an oxide, nitride, oxynitride, silicate, sulfide, selenide, halide or oxyhalide, doped with small amounts of activator ions like rare-earth and/or transition metal ions. Thermographic phosphors exhibit a change in the optical emission spectral intensity or decrease in the decay time curve with temperature, from which the temperature can be calibrated. The sensitivity, temperature range and accuracy of the measurement are determined by the intrinsic characteristics of the phosphor material.

Research Objective

The research objective is to produce a class of host compounds doped with Bi^{3+} , Eu^{2+} and Mn^{2+} using solid state synthesis. The luminescence properties of these dopants is dependent on the host environment, and this gives room to explore its behaviour in loads of hosts. The host materials of interest should be able to promote thermal quenching in these dopants ions in the temperature range of (275 – 350 K). Fig. 1(a-c) shows the temperature-dependent photoluminescence emission, a plot of temperature-dependent lifetime and the plot of calculated temperature sensitivity we obtained from $\text{Sc}_{0.99}\text{VO}_4:0.01\text{Bi}^{3+}$ phosphors in the temperature range of 20 to 60 °C [2].

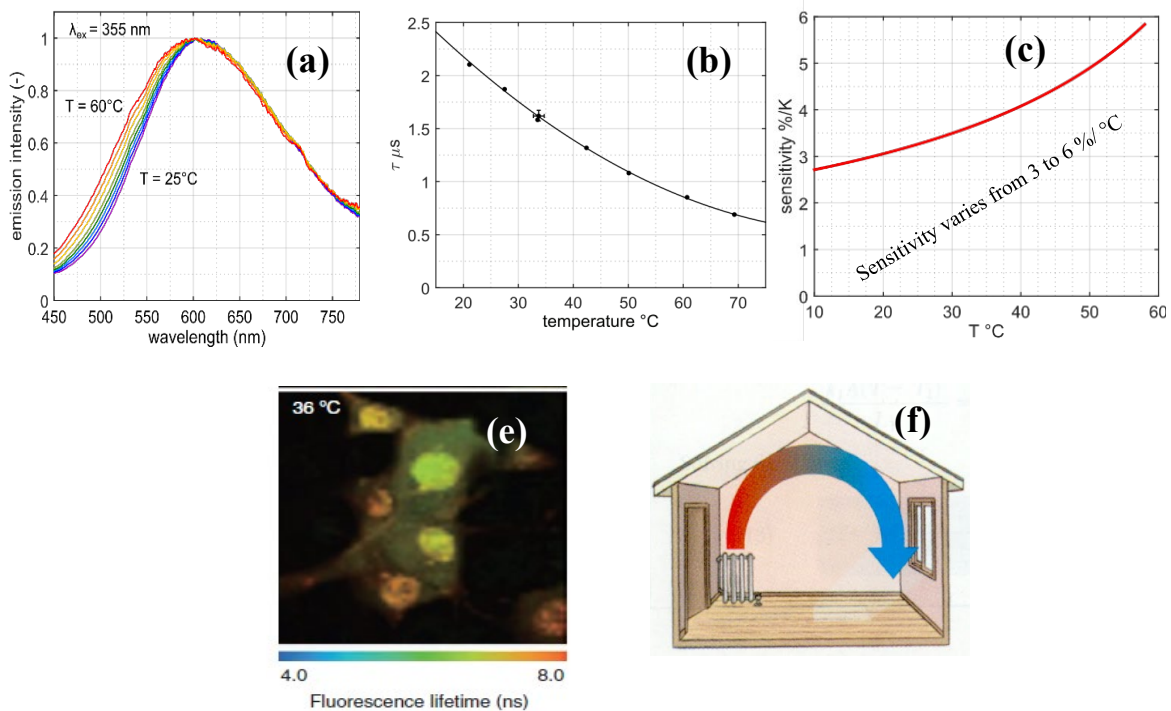


Fig. 1. Temperature-dependent (a) luminescence emission and (b) lifetime, and (c) temperature sensitivity of $\text{Sc}_{0.99}\text{VO}_4:0.01\text{Bi}^{3+}$ phosphors. Possible applications of the phosphor in (e) biological system [1] and (f) convention.

Reference

- [1] K. Okabe, N. Inada, C. Gota, Y. Harada, T. Funatsu, S. Uchiyama, Nat. Commun. 3, (2012) 705.
- [2] C. Abram, I.W. Panjikaran, S.N. Ogugua, B. Fond, Opt. Lett. 45 (2020) 3893.