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Luminescent xerogels: A tool for cryogenic thermometry

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Lanthanide ion-based thermometry is a developing field because it allows temperature detection without direct contact and with high spatial resolution. Lanthanide Organic Gels (LOGs) can be a promising strategy for sensor production, as they are easy to synthesize and can be converted into Lanthanide Organic Frameworks (LOFs) by drying. LOFs have porosity and good photophysical properties. For gel synthesis, an ultrasonic bath was used for 1 hour, where 1,3,5-tris(4-carboxyphenyl)benzene (H_3BTB) in DMF was added to an aqueous solution of Ln^{3+} (Eu^{3+}, Tb^{3+}, and Eu^{3+}/Tb^{3+} in a 5:95 ratio). After drying, xerogels were obtained. The FTIR of H_3BTB showed υ (C=O) at 1680 cm^{-1}, while the spectra of Eu-BTB, Tb-BTB, and Eu_5Tb_{95}-BTB exhibited asymmetric stretching, υa (COO^-), at 1655 cm^{-1} and symmetric stretching, υs (COO^-), at 1387 cm^{-1}, indicating metal-ligand bonding. The PXRD of the xerogels showed similarities with the structure of MIL-103, CCDC number: 288584. Photoluminescence demonstrated a high energy transfer from BTB to the Ln^{3+} ions, with excitation at 335 nm, exhibiting the f-f transitions. Low-temperature sensing from 15 to 135 K of X-Eu_5Tb_{95}-BTB showed a relative sensitivity (Sr) of 0.94 $\%K^{-1}$ at 135 K, suggesting potential application in cryogenic temperatures, as noted by Brites, A. et al. (2016), with a similar LOF. Thus, the Ln-BTB xerogels proved to be promising luminescent thermometers at cryogenic temperatures.

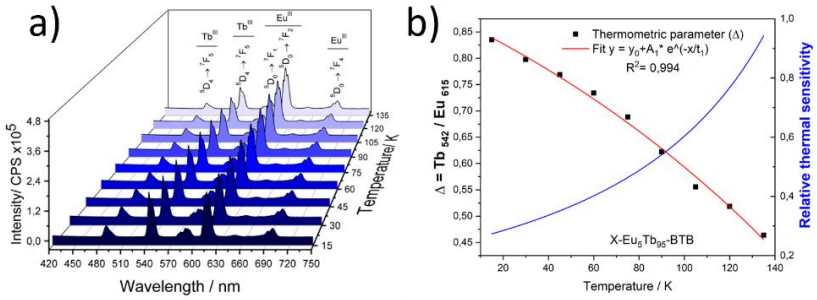

Figure 1. a) Temperature-dependent emission spectra b) Temperature dependence of the thermometric parameter and relative thermal sensitivity

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