XXI Brazilian Meeting on Inorganic Chemistry
X Brazilian Meeting on Rare Earths
III Workshop on Theoretical Bioinorganic Chemistry
Belo Horizonte, September 12 - 15th 2024

Europium Complexes as Luminescent Sensitizers in Near-Infrared Persistent Phosphors

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Thematic Area: Rare-Earths
Keywords: Europium complex, Persistent phosphors, Near-infrared.

Current research on the development of rare-earth-doped luminescent materials using luminescent sensitizers in the form of organic ligands or dyes aims to increase light absorption and tune emission by energy transfer *via* the antenna effect. [1,2] Hence, in this work, we propose the investigation of the *tris*-Eu^{3+} thenoyltrifluoroacetonate (tta) complex as a luminescent sensitizer in novel near-infrared (NIR) persistent phosphors. To synthesize these materials, firstly the europium complex was prepared by precipitation of a solution containing the tta ligand and europium chloride utilizing NH_4OH. Then, a Cr^{3+}-doped mixed Zn/Mg/Sn oxide (ZMSC) persistent phosphor was prepared by the ceramic method, sintering the oxide precursors at 1200 °C. Finally, the Eu^{3+} complex was functionalized on the persistent phosphor by microwave-assisted surface silanization using 3-Aminopropyltrimethoxysilane. Powder X-ray diffraction results revealed an inverse spinel structure of the inorganic phosphor accounting for the formation of M_2SnO_4 (M: Zn and Mg) in addition to a broad band assigned to the formation of a SiO_2 amorphous polymeric shell which supports coordination with the europium complex. UV-Vis and luminescence spectroscopy measurements were performed to probe the band gap energy and electronic transitions, where efficient Eu^{3+} to Cr^{3+} energy transfer was observed by ligand sensitization. Furthermore, X-ray fluorescence (XRF), X-ray absorption near edge structure (XANES), and X-ray excited optical luminescence (XEOL) experiments were carried out using synchrotron radiation (Fig. 1), where Cr and Eu distribution were investigated alongside the absorption and emission profiles under Cr K-edge and Eu L-edge, further supporting the efficiency of the Eu^{3+} complex to sensitize NIR luminescence.

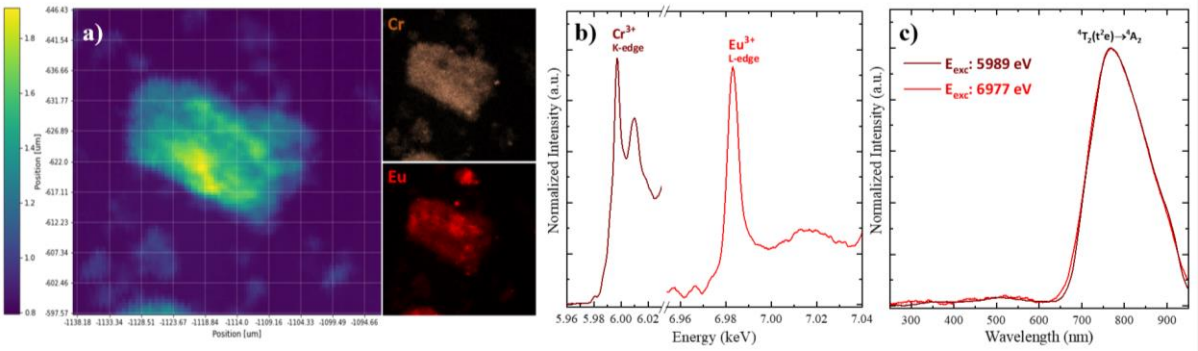

Fig. 1: a) XRF maps filtered for Cr and Eu distribution. b) XANES and c) XEOL spectra recorded under both Cr K-edge and Eu L-edge of ZMSC@SiO_2-Eu(tta)$_3$ persistent phosphor.

Acknowledgments: The authors acknowledge funding provided by the Brazilian agencies CNPq, CNEN, and FAPESP (2021/08111-2)

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