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Europium(III) and terbium(III) molecule-based magnets for tunable photoluminescence

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Materials science develops to obtain intelligent, optical, electronic, and magnetic devices, and increasingly smaller and more efficient.[1] Luminescent single-molecule magnets (LSMMs) are single-phase multifunctional homogeneous materials developed at the molecular level, built from the self-assembling of metal and organic ligands, where the intrinsic characteristics of each element are combined. This comprises covalent bonds to supramolecular interactions, making the system luminescent due to f-f or d-f electronic transitions and magnetic anisotropy, a directional tendency of magnetic properties due to spin-orbit coupling and crystal field effects. Multifunctional materials are used in smart devices that perform multiple tasks simultaneously. Thus, complexes of Dy(III), Tb(III), and Er(III), for instance, generally exhibit slow relaxation of magnetization, and these molecular magnets are expected to transform computing regarding high-density data storage and spintronics.[1,2] In this work, we study trivalent lanthanide ions of Tb and Eu with an oxamate ligand to investigate photoluminescence in the visible region and their magnetic properties. This new ligand, based on an oxamate-substituent named L, was studied, and its correspondent potassium(I) salt KL was synthesized and characterized. The reaction between KL in mild conditions and europium(III) or terbium(III) lanthanide salts in a 3:1 ratio afford new compounds TbL and EuL. Then, through the reaction between KL and terbium(III) or europium(III) salts in the following proportions Tb/Eu 98:2, 2:98, 90:10, 10:90, 80:20, 20:80 and 50:50, respectively, a series of new doped oxamate compounds were synthesized. All compounds were characterized by elemental analysis, infrared spectroscopy, X-ray diffraction patterns, and thermal analysis, and submitted to UV light of (254 and 365 nm) to verify their tunable photoluminescence. We show how the doping of Tb/Eu metal complexes in the ratio described provides photoluminescence in various shades of the visible region of electromagnetic spectra. Such compounds have potential applications such as light-emitting conversion diodes and spintronics, in addition to being sensitive to the exchange of solvents and UV light.

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References

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