

Evidences of the participation of excited states in the positronium formation mechanism in $\text{Sm}_{1-x}\text{Eu}_x(\text{dpm})_3$ solid solutions studied by optical and positron annihilation spectroscopies

F. Fulgêncio^{1*}, R. Sábio², S.J. Ribeiro², A.S. Borges³, F.C. Oliveira⁴, M. H. Araújo¹,
D. Windmüller¹, A. Marques-Netto¹, J.C. Machado¹, W.F. Magalhães¹

¹ Departamento de Química, UFMG, Belo Horizonte-MG, Brazil.

² Institute of Chemistry- São Paulo State University- UNESP, Araraquara-SP, Brazil

³ Coordenadoria de Química e Biologia, IFES, Campus Vitória-ES, Brazil.

⁴ Centro Federal de Educação Tecnológica de Minas Gerais (CEFET-MG), Campus Timóteo, Timóteo-MG, Brazil.

*email: fefulgencio@gmail.com

Positron annihilation lifetime (PALS) and optical spectroscopies measurements were performed in solid solutions of general formula $\text{Sm}_{1-x}\text{Eu}_x(\text{dpm})_3$, (dpm = 2,2,6,6-tetramethyl-3,5-pentanedionate). The results indicate that intra and intermolecular photophysical processes, such as the presence of low energy ligand-to-metal charge transfer (LMCT) states and $\text{Sm}^{3+} \rightleftharpoons \text{Eu}^{3+}$ energy transfers, play a major role on both luminescence lifetime quenching and positronium (Ps) formation probability. The results were interpreted from a recently proposed kinetic model which involves the participation of excited states in the Ps formation, called correlated cybotactic system kinetic mechanism (CCSKM). An equation, which satisfactorily fits the Stern-Volmer type experimental Ps yields data, was obtained correlating the Ps yields with the ligand's $^3\pi^*$ excited state population in the cybotatic correlated system $\{e^{+*} L^* \text{Sm}\}$. Also, we correlated the Ps inhibition constant k obtained for $\text{Sm}_{1-x}\text{Eu}_x(\text{dpm})_3$ and $\text{Tb}_{1-x}\text{Eu}_x(\text{dpm})_3$ solid solutions with energy and charge transfer processes.

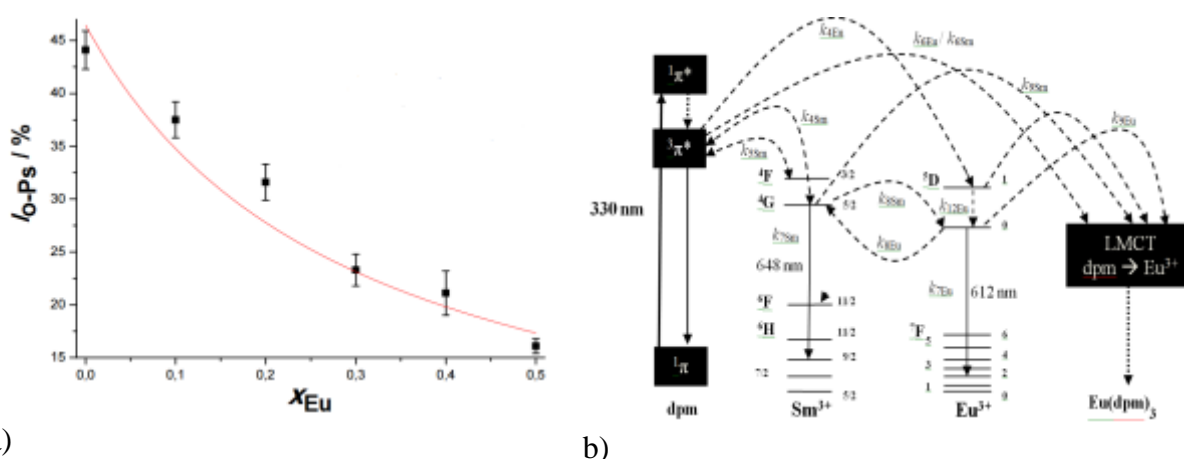


Fig.1. $I_0\text{-Ps}$ (%) as a function of the mole fraction of Eu^{3+} (x_{Eu}) in $\text{Sm}_{1-x}\text{Eu}_x(\text{dpm})_3$ solid solutions (a) and Partial energy level diagram for the relevant photophysical processes associated with photoluminescence in $\text{Sm}_{1-x}\text{Eu}_x(\text{dpm})_3$ solids solutions.

[1] F. Fulgêncio, F.C. Oliveira, D. Windmüller, H.F. Brito, O.L. Malta, G.F. Sá, W.F. Magalhães, J.C. Machado, *Phys. Chem. Chem. Phys.* **14**, 9996 (2012)