Eu^{3+} AS A LUMINESCENT PROBE FOR LOCAL SITE SYMMETRY IN Eu(III) COORDINATION COMPOUNDS

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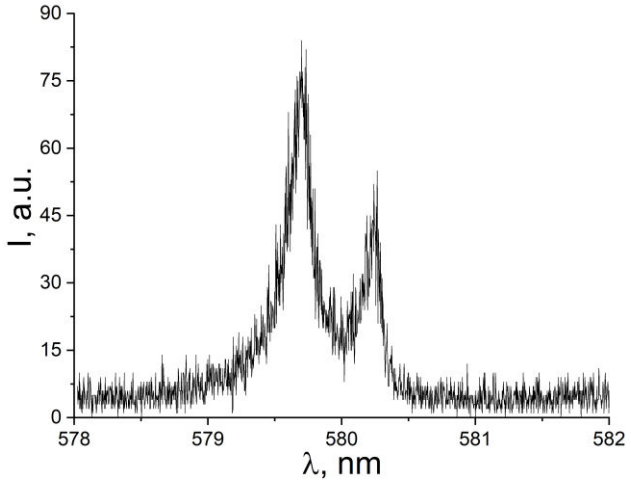
Eu(III) coordination compounds attract a lot of interest because of their excellent properties, both from the application point of view as well as from the pure theoretical aspects [1,3]. Usually under the UV or blue-light excitation the Eu^{3+} complex exhibits a bright-red luminescence with narrow atomic-like emission bands. Because of relatively small number of ^7F_J components in the PL emission spectrum the Eu(III) ion is convenient when analysing the PL spectra, drawing information and making conclusions vs the symmetry properties of the specific complex. The topic of this paper encompasses the use of Eu(III) ion as a site symmetry probe in lanthanide coordination compounds.

We discuss a number of important aspects on the use of tripositive ion Eu^{3+} for evaluation of local symmetry in europium(III) coordination compounds. When examining these aspects, we bring both the literature data as well as our own experimental results [2]. As one of example we discuss the PL spectra on the binuclear complex $[Eu(\mu_2\text{-}OC_2H_5)(NO)_3(phen)]_2phen$ [3]. In general, the character of PL bands splitting is directly related to the symmetry of the complex, and Table 1 taken from [4] illustrates this aspect.

Table 1. Stark-level splitting for specific crystal field symmetries vs the total angular momentum J [4].

Local Symmetry	**Triclinic (C_1, C_i)**	**Monoclinic (C_s, C_2, C_{2h})**	**Rhombic (C_{2v}, D_2, D_{2h})**
J = 0	1	1	1
J = 1	3	3	3
J = 2	5	5	5
J = 3	7	7	7

One of the very interesting features of Eu^{3+} PL spectra is the emission band at ca 580 nm, associated with the transition $^5D_0 \rightarrow {}^7F_0$. Because both $^5D_0$ and $^7F_0$ levels are non-degenerate, the number of components related to this band indicates on the number of different Eu(III) sites in the coordination compound. Figure 1 illustrates two components of the transition $^5D_0 \rightarrow {}^7F_0$ for the binuclear complex $[Eu(\mu_2\text{-}OC_2H_5)(NO)_3(phen)]_2phen$. Registration of two components in this transition indicates on two emission sites of this complex. One has to be careful when drawing conclusions based on PL spectra, and excellent reviews on these aspects are presented by K. Binnemans [5] and P. Tanner [6]. Actually, the final assignment of the point group symmetry can be made on the basis of XRD measurements.



[1] P. Serna-Gallen et al. *Ceramics International* **49** (2023) 41078-41089.
[2] V. Ghenea et al. *Journal of Engineering Science* (2024) – to be published.
[3] I. Culeac et al. *Nanomaterials* **12** (2022) 2788.
[4] T.N.L. Tran et al. *Materials* **15** (2022) 1847.
[5] K. Binnemans. *Coordination Chemistry Reviews* **295** (2015) 1 – 45.
[6] A.P. Tanner al. *Royal Society of Chemistry* **42** (2013) 5090 – 5101.