

Luminescent Properties of Lanthanide Complexes with Phosphine Oxide Ligands Containing Polyaromatic Frameworks

(Faculty of Engineering, Hokkaido University) ○Yuichi Kitagawa

Keywords: Lanthanide complex; Luminescence; Europium; Polycyclic aromatic hydrocarbon; Sensor

Lanthanides include 15 elements (Figure 1a, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu), which form stable trivalent ions. The lanthanide ions are characterized by an incompletely filled 4f shell (with the exception of Lu(III)). The 4f orbitals are shielded from the surrounding by the filled 5s and 5p orbitals. Therefore, 4f–4f electronic transitions produce sharp emission lines

(full width at half-maximum, (fwhm) < 10 nm).¹⁻² Lanthanide(III) complexes, composed of lanthanide(III) ions (with a luminescent center) and organic ligands (strong light absorbers), provide strong luminescence (Figure 1b–c). Organic ligand design is a key factor for the enhancement of brightness. Recently, I have built some model systems of strongly luminescent lanthanide complexes with phosphine oxide ligands based on polycyclic aromatic hydrocarbons.³⁻⁷ These complexes displayed both bright emission³⁻⁴ and physical sensing properties.⁵⁻⁷ In this presentation, I will showcase a novel molecular design strategy for bright luminescent lanthanide complexes with polyaromatic-based ligands.

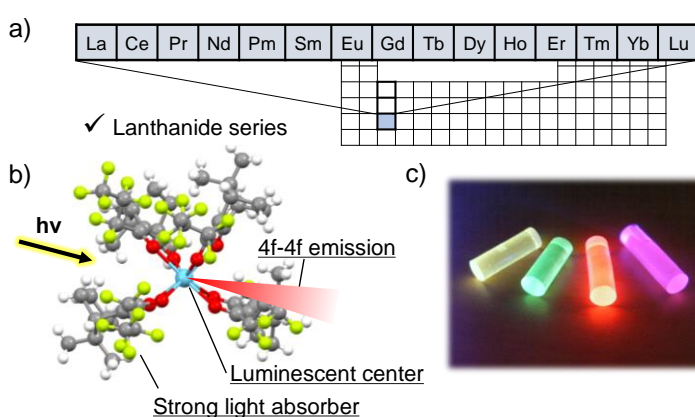


Fig. 1 (a) Lanthanides in the periodic table, (b) Structure of the luminescent lanthanide complex (c) Luminescent photograph based on lanthanide complexes.

- 1) J.-C. G. Bünzli, *Coord. Chem. Rev.* **293**, 19-47 (2015).
- 2) J.-C. G. Bünzli, *Chem. Rev.*, 2010, **110**, 2729–2755.
- 3) Y. Kitagawa, F. Suzue, T. Nakanishi, K. Fushimi, Y. Hasegawa, *Dalton Trans.* **47**, 7327-7332 (2020).
- 4) Y. Kitagawa, F. Suzue, T. Nakanishi, K. Fushimi, T. Seki, H. Ito, Y. Hasegawa, *Commun. Chem.* **3**, 1–7 (2020).
- 5) Y. Kitagawa, M. Kumagai, T. Nakanishi, K. Fushimi, Y. Hasegawa, *Inorg. Chem.* **59**, 5865–5871 (2020).
- 6) Y. Kitagawa, M. Kumagai, P. P. Ferreira da Rosa, K. Fushimi, Y. Hasegawa, *Chem. Eur.-J.* **27**, 264-269 (2021).
- 7) Y. Kitagawa, A. Naito, K. Fushimi, Y. Hasegawa, *Chem. Eur.-J.* **27**, 2279-2283 (2021).