

ORIGINAL PAPER

Synthesis and photophysical properties of new Ln(III) (Ln = Eu(III), Gd(III), or Tb(III)) complexes of 1-amidino-*O*-methylurea

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Three new solid lanthanide(III) complexes, $[\text{Ln}(\text{1-AMUH})_3] \cdot (\text{NO}_3)_3$ (1-AMUH = 1-amidino-*O*-methylurea; Ln = Eu(III), Gd(III), or Tb(III)) were synthesised and characterised by elemental analysis, infrared spectra, magnetic moment measurement, and electron paramagnetic resonance (EPR) spectra for Gd(III) complex. The formation of lanthanide(III) complexes is confirmed by the spectroscopic studies. The photophysical properties of Gd(III), Eu(III), and Tb(III) complexes in solid state were investigated. The Tb(III) complex exhibits the strongest green emission at 543 nm and the Eu(III) complex shows a red emission at 615 nm while the Gd(III) complex shows a weak emission band at 303 nm. Under excitation with UV light, these complexes exhibited an emission characteristic of central metal ions. The powder EPR spectrum of the Gd(III) complex at 300 K exhibits a single broad band with $g = 2.025$. The bi-exponential nature of the decay lifetime curve is observed in the Eu(III) and Tb(III) complexes. The results reveal them to have potential as luminescent materials.

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Introduction

Lanthanide ions and their complexes have attracted increased interest in recent decades because of their unique optical, spectroscopic, and paramagnetic properties, which render them an interesting field of research in coordination and supra-molecular chemistry (Bünzli & Piguet, 2002; Prasad et al., 2011). Some of the lanthanide(III) complexes with chelating ligands possess numerous potential applications, such as organic light-emitting devices (OLED), liquid crystalline materials, sensors and magnetic resonance imaging (MRI), and contrast agents (Kido & Okamoto, 2002; Binnemans & Görller-Walrand, 2002; Mahajan et al., 2004; Aime et al., 1996). The structural chemistry of the lanthanides attracts interest because they exhibit a tendency to form complexes with coordination numbers greater than six and up to twelve. However, the lanthanide coordination poly-

mers bridged by the small conjugated ligands, such as cyano, acetate, salicylate, azido, nitrido, oxalate, and dicyanamide, remain inadequately explored (Costes et al., 2002; Wu et al., 2004). The luminescence of these lanthanide(III) complexes having an attached absorbing chromophore is often very efficient and can be readily adjusted from visible to the near infrared region simply by the selection of lanthanide(III) ions. As a result, the characteristic luminescence properties of these lanthanide(III) complexes, as well as their applications, have recently been reviewed (Bünzli et al., 2010; Binnemans, 2009).

The majority of the lanthanide(III) complexes studied were derived from strongly chelating anionic ligands with oxygen donor sites in their coordination mode of linkage. Nitrogen donor coordination was well characterised only in association with oxygen donors, as exemplified by the polyaminepolycarboxylates and 8-quinololates (Moeller et al., 1965,

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