

Near-infrared emitting organolanthanide systems

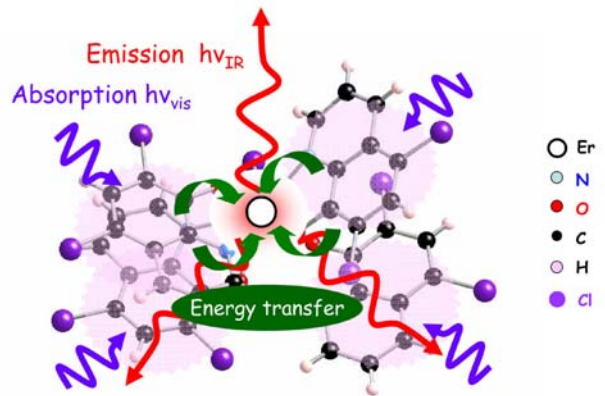
Motivation

Organometallic complexes with lanthanide ions represent a new class of materials for light emitters and amplifiers in the near infrared (NIR) telecom windows. Organolanthanides offer several advantages over conventional rare-earth-ion-doped glasses:

- larger absorption cross-sections in the visible spectral window
- larger lanthanide stimulated emission cross-sections [1]
- larger emission bandwidths [2]

→ Potential for realizing plastic optical amplifiers integrated in photonic circuits

Intrinsic limitations for achieving efficient NIR emission and optical gain arise from the presence of nonradiative deactivation channels. In erbium (Er) complexes, relevant for applications in the 1.5 μm window, coupling of the Er^{3+} electronic levels with high-frequency vibrations of C–H and O–H groups results in dramatic reduction in Er^{3+} excited-state lifetime from millisecond to microseconds [1,3,4]



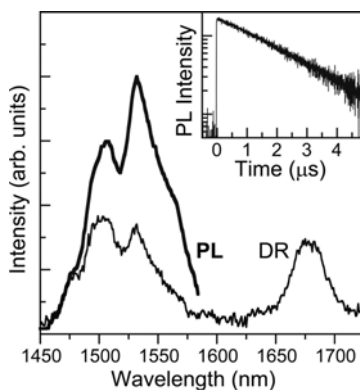
Schematic of a mononuclear organolanthanide (Er) complex. Visible light is absorbed by the organic ligand. Energy is radiationlessly transferred to the Er ion, which emits in the NIR.

Main challenges

- Suppression of the Er nonradiative decay
- Demonstration of net gain in planar waveguides

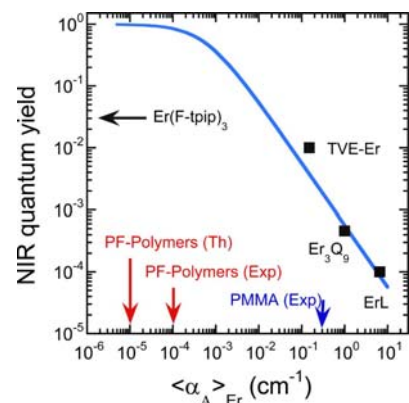
Our contribution

- Structural and optical characterization of Er-quinolinolate complexes [4]
- Quantitative understanding of the Er nonradiative decay processes [4]
- Definition of a strategy for achieving bright NIR emission from Er complexes [5]



Left. Photoluminescence (PL) and diffuse reflectance (DR) spectra of the trinuclear Er_3Q_9 complex (Q = 8-quinolinolate). Inset: PL time decay trace [4]

Right. Model calculation of the Er NIR emission quantum yield vs. vibrational absorption at 1.54 μm (blue line). Experimental values (squares and black arrow). NIR absorption losses in different polymer hosts (red and blue arrows, PF=perfluorinated) [5]



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