LANTHANIDE-BASED NEAR-INFRARED EMITTERS FOR PHOTONIC INTEGRATED CIRCUITS AND QUANTUM OPTICS

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Optical and photonic systems are nowadays at the heart of modern technology towards sustainable and energy-efficient devices for computing, communication, data security, including linear photonic integrated circuits and the newly emerging frontier of quantum optics. The high color pure and long lived emission delivered by the lanthanide intra-atomic f-f transitions establishes a unique value for the realization of such devices, which require efficient near-infrared optical output but also the opportunity for wavelength tunability allowing for signal multiplexing.
In this contribution, we show how controlling the multi-step emission photocycle in organically-sensitized lanthanide based systems is an exceptional opportunity for achieving efficiency enhancement and light color tunability. By tailoring the chemical nature, shape, geometry, size and electronic density distribution of the organic sensitizer, highly efficient dye-sensitized multi-layered nanoparticles with multimodal upconversion/downshifted (C-band) emission[1-2] and dual near-infrared (O-band) and mechanochromic tunable visible orange-to-panchromatic white light emission in a dysprosium single molecular complex have been realized.[3] Finally, we propose such materials as a new paradigm in single-photon generation for quantum optics (EIC Pathfinder Challenges "ARTEMIS – Molecular materials for on-chip integrated quantum light sources" GA 101115149).

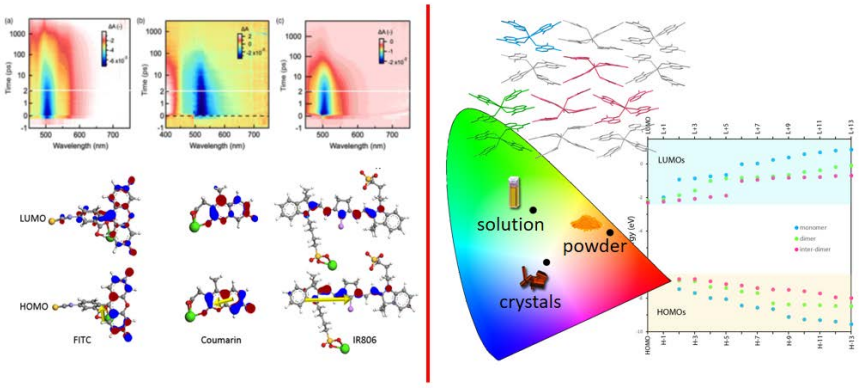

***Figure 1**: Left. 2D TA maps showing the excited state ultrafast dynamics and DFT calculated frontier MOs and transition dipole moments in Ln^{3+} doped nanoparticles with three different dyes. Right. Supramolecular architecture, DFT calculated electronic levels and CIE color coding diagram for a Dy-quinolinolate single molecule mechanochromic emitter.*

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[3] F. Artizzu *et al.*, *J. Mater. Chem. C*, **2021**, *9*, 15641.