Near-Infrared to Visible Light-Upconversion in Molecules: From Dream to Reality

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In 2002, the thorough investigation of non-radiative relaxation processes operating in molecular lanthanide complexes led to the conclusion that *there is no chance to induce and observe upconversion luminescence in these molecular compounds*.[1] On the other side, lanthanide-containing garnet proved to be cleared of deleterious high-energy vibrational processes.[2] Consequently lanthanide-doped nanoparticles are currently (over)exploited for inducing optical upconversion processes and they find profitable applications in solar cell technologies and in biomedical applications; this despite the limited control over their synthesis and reproducibility.[3] This tutorial lecture aims at presenting the background and the virtues of linear *versus* non-linear optics for decreasing (downshifting, downconversion) or for raising (upconversion) the energy of incident photons interacting with molecules. Particular attention will be focused on the unprecedented implementation of upconversion at the molecular level *via* the design of heterometallic polynuclear coordination complexes overcoming the 2002's limitation (Figure 1).[4]

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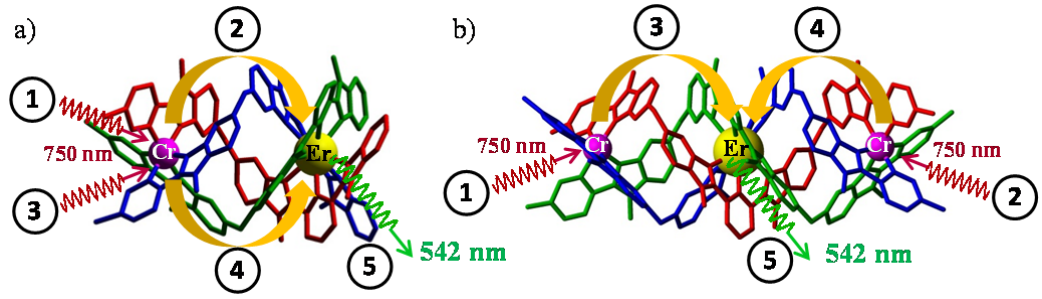

Figure 1: The two mechanisms responsible for ETU upconversion operating in Cr/Ln complexes at the molecular level. (a) Er-centred pathway highlighted for the Cr/Er pair and (b) Cr-centred pathway in the CrErCr triad.

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