Tuning Upconversion in Lanthanide-Doped Core−Shell Nanoparticles

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Abstract: Lanthanide-doped upconversion nanoparticles, characterized by ultraviolet and visible emission on near infrared excitation, are promising for a variety of modern-day technologies including 3D display, photovoltaics, data storage, and cancer therapy. An upconversion process usually involves a number of complex electronic transitions and therefore is highly susceptible to non-radiative quenching caused by cross relaxations between dopant ions and by high energy oscillators in the host lattice or on the particle surface and deleterious. To minimize the non-radiative energy losses, the nanoparticle composition should be carefully designed and stringently controlled, which impose certain constraints on tuning the absorption and emission spectra. Herein, we show that through combining core−shell structural engineering and energy migration, incompatible lanthanide ions can be integrated into a single nanoparticle with well-defined energy exchange interactions. The effects enable isolation and independent manipulation of excitation and emission processes at separate layers of a core−shell nanoparticle, thereby offering substantial flexibility in upconversion fine tuning. The improved control over photon energy conversion would open up new opportunities for biological and energy applications.

References:

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