Multiphoton emissions in lanthanide nanoparticles

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Lanthanide nanoparticles, with frequency upconverted and downconverted emissions, have shown great potential in photovoltaics, miniaturized optics, optical sensing, and imaging applications. However, the energy transfer among lanthanide ions plays important roles in controlling the transition behavior, and cross-relaxation which is inevitably happened between neighboring lanthanide ions or laddering energy levels itself, is considered to be deleterious to lower the transition probability and color purity. Here, we present a study on cross-relaxation in lanthanide ions, that can sustain interionic energy loop as a chain reaction and manipulate the electron population of higher-lying emissive levels. Importantly, the intermediates are long-lived and promote multipath interionic energy loops via sets of crucial cross-relaxations, enabling multicolor frequency upconverted emissions. With rationally engineered transition kinetics, the emissions with multiphotons under mild excitation were achieved. These processes rendered a higher lateral imaging resolution, *ca*. 1/12th of the excitation wavelength. These findings enlighten the manufacturing of multiphoton fluorophores for versatile optical and biological applications.

Short Bio:

Lingdong Sun received her PhD degree in Condensed Matter Physics from Changchun Institute of Physics, Chinese Academy of Physics. Following a postdoctoral fellowship, she joined the faculty at Peking University, and was promoted to associate professor and professor. She worked as a visiting professor at Keio University and Kyoto University. Her current research focuses on the synthesis and applications of rare earth and semiconductor nanomaterials.