Photoswitching upconversion emission with high-energy irradiation

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Lanthanide-doped upconversion nanoparticles (UCNPs) have emerged as a key class of luminescent nanomaterials, exhibiting anti-Stokes spectral shift, narrow emission bands, multicolor emission, and long luminescence lifetimes [1]. These characteristics make UCNPs ideal candidates for a wide range of applications, including high-resolution imaging, theranostics, sensing, displays, data storage, lasing, and photoswitching. However, it is crucial to develop techniques to tuning upconversion emission color and intensity for the future use of UCNPs in a variety of contexts [2].

We show the photoswitching of upconversion emission from UCNPs with high-energy irradiation for optical switching applications (Fig. 1A). The co-precipitation method was used to synthesize tailored UCNPs that showed multicolor upconversion emission under 980-nm excitation. These UCNPs were morphologically and optically characterized. We used high-energy light to irradiate these UCNPs while detecting time-dependent changes in upconversion emission (Fig. 1B), which we ascribed to lanthanide ion valence state shifts. With high selectivity and low light intensity, we regulated upconversion emission. These findings offer new avenues for optical switching and other cutting-edge applications in bioscience and nanophotonics enabled by UCNPs.

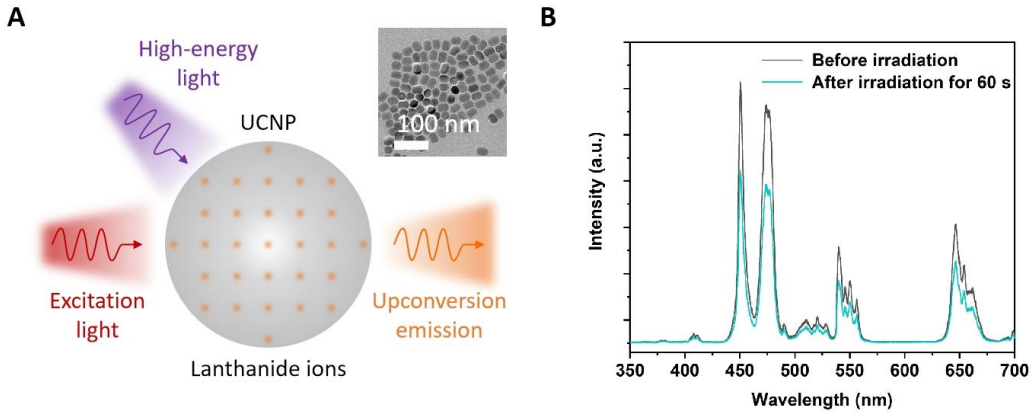

Figure 1: A) Schematic of tuning upconversion emission from UCNPs with high-energy light irradiation. Inset: transmission electron microscopy imaging of UCNPs. B) Intensity of upconversion emission from UCNPs before and after irradiation for 60 s with high-energy light.

[1] F. Auzel, *Chem. Rev.* **104**, 139 (2004).

[2] Z. Zheng *et al.*, *Nano Today* **29**, 100797 (2019).