Design and application of upconversion nanocrystals for sensing and lasing at single particle level

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Due to the unique nonlinear upconverting properties, lanthanide-doped nanocrystals have been widely applied in biomedicine, imaging, sensing, detection, miniaturized optical devices, etc. Nonetheless, the routine optical properties of nanocrystal ensembles (solution or powder) ignored interparticle discrepancy in size, shape, defect, composition, surface status, etc [1]. Herein, single-particle spectroscopy is used to reveal the diverse optical properties and functionalities of upconversion nanocrystals. Based on the well-designed core-shell structure and modulation of localized activators distribution, a novel upconversion nanoprobe with near-unity Förster resonance energy transfer efficiency at single particle level is achieved for ultra-sensitive sensing [2]. What's more, cross-relaxation among intraparticle neighboring emitters is well-controlled and employed for increasing the luminescence efficiency at specific wavelengths and lowing the threshold to reach population inversion. By homogenously coupling to a microcavity, we demonstrate the nanocrystals to be great gain media for upconverted lasing emission with an ultralow threshold of continuous wave excitation at room temperature. These studies suggest a great potential to using the well-designed upconversion nanocrystals as efficient nanoprobe and gain medium for sensing and lasing.

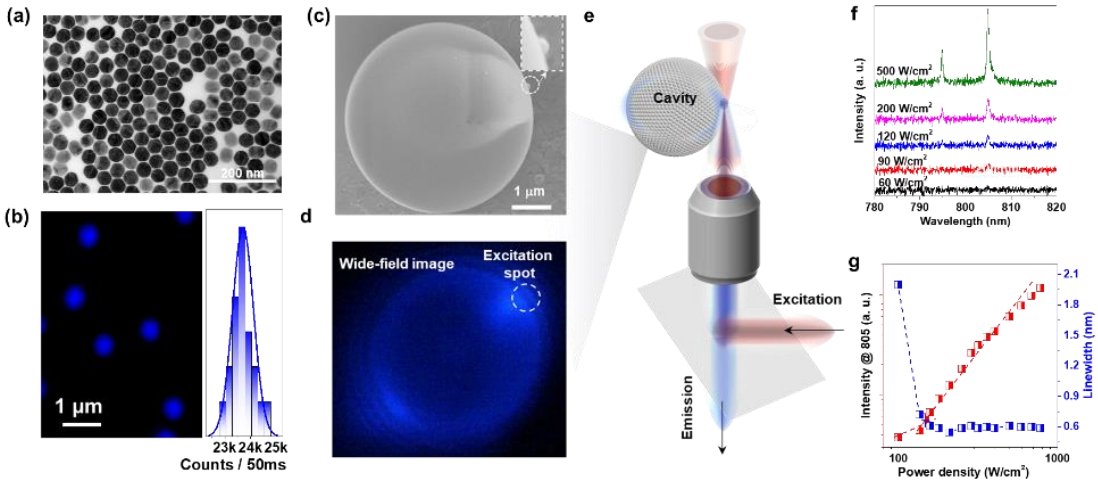

Figure 1 Characteristic of single upconversion nanocrystals and realization of upconverting microlasers

References

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