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Near-Infrared Excited Nanoparticles: Towards a Multimodal Platform

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Near-infrared (NIR) excited nanomaterials are emerging as useful tools in diagnostic medicine and therapeutics. Excitation with NIR light mitigates some of the drawbacks associated with the use of UV as the excitation source. NIR light is silent to tissues thus minimizing autofluorescence, possesses greater tissue penetration capabilities and does not incur damage to the sample. In this regard there has been an ever-increasing interest in lanthanide (Ln3+)-doped upconverting nanoparticles. With upconverting nanoparticles, it is possible to obtain UV/visible/NIR emissions using a single NIR excitation source (typically 980 nm) via a process known as upconversion. This multiphoton excitation process differs from what occurs in conventional multiphoton excited materials where the absorption of photons is simultaneous. In the case of Ln3+-doped materials, the multitude of long-lived "real"electronic energy states of the Ln3+ ions (from the partially filled 4f shell) allow for sequential absorption of multiple NIR photons eliminating the need for complex and expensive optical excitation. Thus, upconverted luminescence can be observed using an inexpensive commercial continuous wave diode laser.

Here, we present the synthesis and surface functionalization of Ln3+-doped upconverting nanoparticles and demonstrate how they can be used in biological applications due to their interesting optical properties. Furthermore, we will show how these upconverting nanoparticles can be used as building blocks towards developing a multifunctional nanoplatform for the potential diagnostics and therapeutics of diseases such as cancer.

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