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Upconversion Nanoparticles for Imaging and Controlled Photothermal Release of Anticancer Drug in Breast Cancer

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Abstract : The Anti-Stoke upconversion process has been used extensively for bioimaging and is recently being used for photoactivated therapy in cancer utilizing upconversion nanoparticles (UCNs). The UCNs have an excitation band at 980nm; 980nm laser excitation used to produce UV/Visible emissions also produce a heating effect. Light-to-heat conversion has been observed in nanoparticles(NPs) doped with neodymium(Nd) or ytterbium(Yb)/erbium(Er) ions. Despite laser-induced heating in Rare-earth doped NPs being proven to be a relatively efficient process, only few attempts to use them as photothermal agents in biosystems have been made up to now. Gold nanoparticles and carbon nanotubes are the most researched and developed for photothermal applications. Both have large heating efficiency and outstanding biocompatibility. However, they show weak fluorescence which makes them harder to track in vivo. In that regard, UCNs are attractive due to their excellent optical features in addition to their light-to-heat conversion and excitation by NIR, for imaging and spatiotemporally releasing drugs. In this work, we have utilized a simple method to coat Nd doped UCNs with thermoresponsive polymer PNIPAM on which 4-Hydroxytamoxifen (4-OH-T) is loaded. Such UCNs demonstrate a high loading efficiency and low leakage of 4-OH-T. Encouragingly, the release of 4-OH-T can be modulated by varying the power and duration of the NIR. Such UCNs were then used to demonstrate imaging and controlled photothermal release of 4-OH-T in MCF-7 breast cancer cells.

Keywords : cancer therapy, controlled release, photothermal release, upconversion nanoparticles
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