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Photomagnetic Nanoparticles in Dual-modality Imaging and Photo-sonodynamic Activity against Bacteria

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Abstract

Demands on effective diagnosis and therapy, especially in the antibacterial field, are increasing. This study presents multifunctional Fe₃O₄@NaGdF₄:Yb:Er-HMME (Fe@UCNP-HMME) nanoparticles for applications in bioimaging as well as photodynamic therapy (PDT)/sonodynamic therapy (SDT). We constructed a core-shell structure of Fe₃O₄ and upconversion nanoparticles (UCNPs) for T₂-weighted MRI and upconversion luminescence (UCL) imaging both in vitro and in vivo. Moreover, we modified the surface of the Fe@UCNPs with the photo/sonosensitizer hematoporphyrin monomethyl ether (HMME), which could be excited to produce ¹O₂ for photo/sonodynamic antimicrobial chemotherapy (PACT). Furthermore, deep tissue penetration of UCL and ultrasound led to the temporal induction of cytotoxicity when applied to drug-resistant Gram(+) and Gram(-) bacteria, by which these pathogens were efficiently killed through damage of the cell wall structure. In summary, we

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