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PII: S0168-3659(18)30552-2
DOI: doi:10.1016/j.jconrel.2018.09.022
Reference: COREL 9474

To appear in: *Journal of Controlled Release*

Received date: 2 May 2018
Revised date: 15 September 2018
Accepted date: 24 September 2018

Please cite this article as: Hui Wang, Qingxin Mu, Richard Revia, Kui Wang, Bowei Tian, Guanyou Lin, Woncheol Lee, Yang-Ki Hong, Miqin Zhang , Iron oxide-carbon core-shell nanoparticles for dual-modal imaging-guided photothermal therapy. Corel (2018), doi:10.1016/j.jconrel.2018.09.022

Iron oxide-carbon core-shell nanoparticles for dual-modal imaging-guided photothermal therapy

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Keywords: hybrid nanoparticles; carbon shell; magnetic core; multi-modal imaging; photothermal therapy

Abstract: Nanostructured materials that have low tissue toxicity, multi-modal imaging capability and high photothermal conversion efficiency have great potential to enable image-guided near infrared (NIR) photothermal therapy (PTT). Here, we report a bifunctional nanoparticle (BFNP, ~16 nm) comprised of a magnetic Fe_3O_4 core (~9.1 nm) covered by a fluorescent carbon shell (~3.4 nm) and prepared via a one-pot solvothermal synthesis method using ferrocene as the sole source. The BFNP exhibits excitation wavelength-tunable, upconverted and near-infrared (NIR) fluorescence property due to the presence of the carbon shell, and superparamagnetic behavior resulted from the Fe_3O_4 core. BFNPs demonstrate dual-modal imaging capacity both in vitro and in vivo with fluorescent imaging excited under a varying wavelength from 405 nm to 820 nm and with T_2-weighted magnetic resonance imaging (r_2 = 264.76 mM^{-1} s^{-1}). More significantly, BFNPs absorb and convert NIR light to heat enabling photothermal therapy as demonstrated