

Magnetic Iron Oxide-Fluorescent Carbon Dots Integrated Nanoparticles for Dual-modal Imaging, Near-infrared Light-responsive Drug Carrier and Photothermal Therapy

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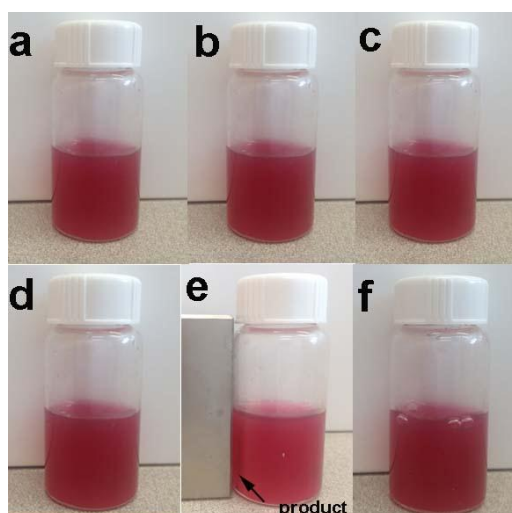


Figure S1. (Up) The photographs of the dispersions (0.2 mg/mL) of the Fe₃O₄@C-CDs hybrid NPs in cell culture medium with different storage time: (a) 0 day, (b) 3 days, and (c) 6 days. (Down) The photographs of the dispersions (0.2 mg/mL) of the hybrid NPs in culture medium (d) without magnetic field, (e) with

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magnetic field for 1 min, and (f) after the removal of magnetic field.

The results in Figure S1 indicate that the hybrid NPs dispersed very well in the cell culture medium at a concentration of 0.2 mg/mL. No obvious aggregation was observed even after six days storage of the hybrid NPs in culture medium, which indicates that the hybrid NPs has good stability in culture medium. In addition, the dispersion of the hybrid NPs in culture medium demonstrated reversible magnetic response. When the NP dispersion was subjected to a magnetic field (0.30 T), the NPs were attracted toward the magnet within minutes. Slight agitation can bring the hybrid NPs back into the uniform dispersion after the magnet was removed, as shown in Figure S1(f). These results show that hybrid NPs has excellent dispersing ability in cell culture medium, which is very important for future applications in bioseparation, storage, and magnetic targeting drug delivery.

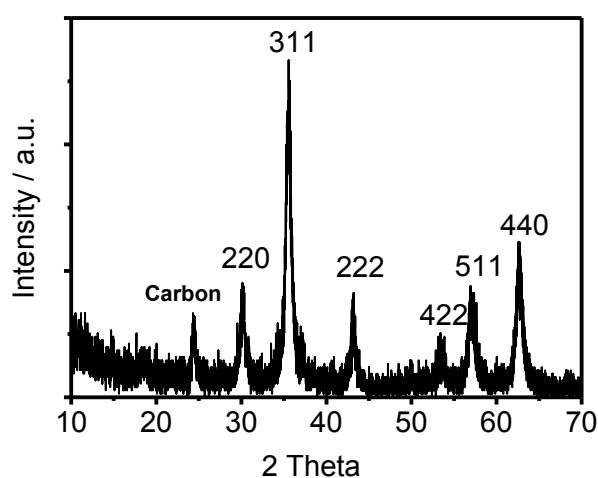


Figure S2. Typical XRD pattern of the as-obtained Fe_3O_4 @C-CDs NPs.

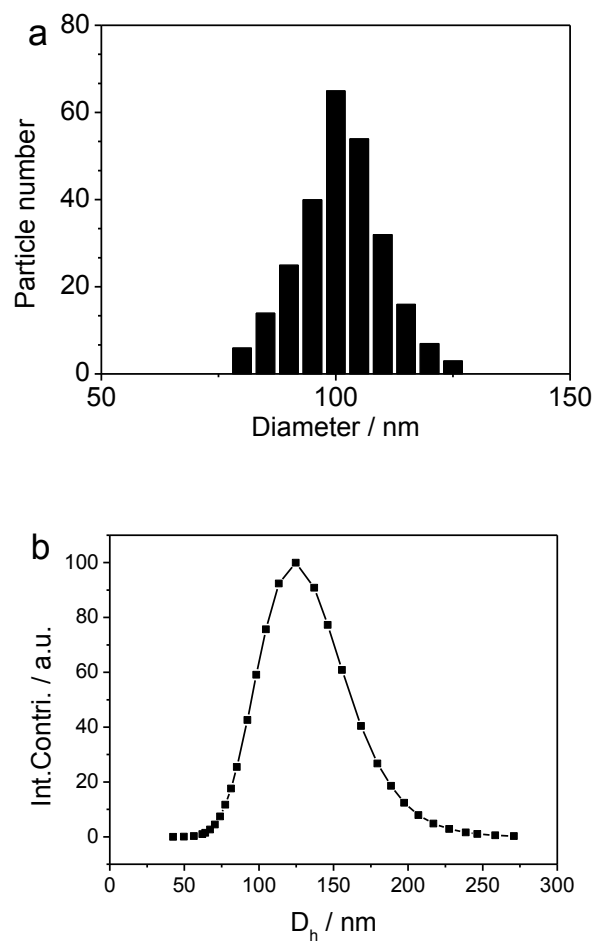


Figure S3. (a) Size distribution of the dried Fe₃O₄@C-CDs NPs on TEM images; (b) Hydrodynamic diameter distribution of the hybrid NPs dispersed in water obtained at a scattering angle $\theta = 60^\circ$ and $T = 22^\circ\text{C}$.

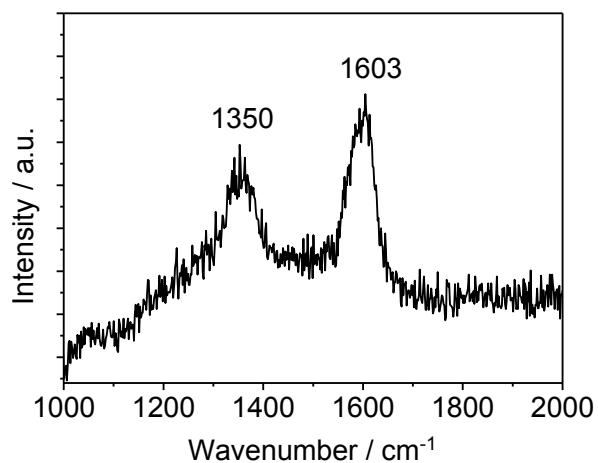


Figure S4. Typical Raman spectrum of the as-obtained Fe₃O₄@C-CDs NPs.

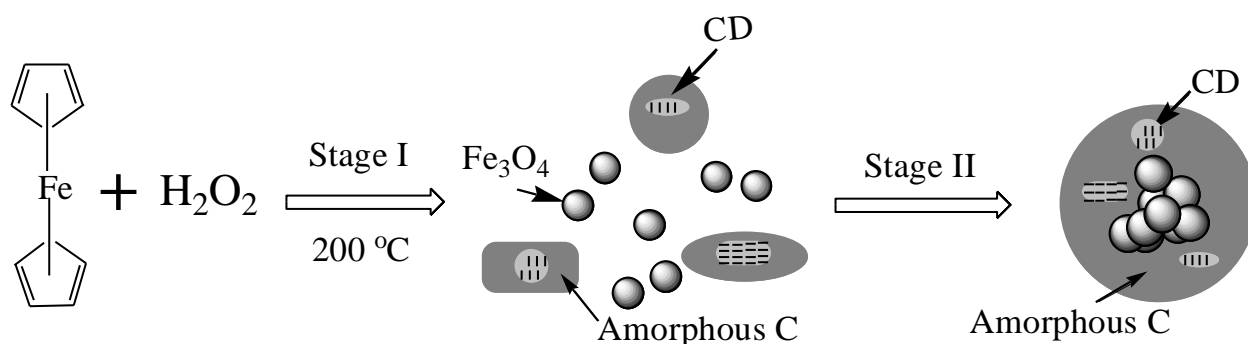


Figure S5. Schematic illustration of the formation of Fe₃O₄@C-CDs hybrid NPs.

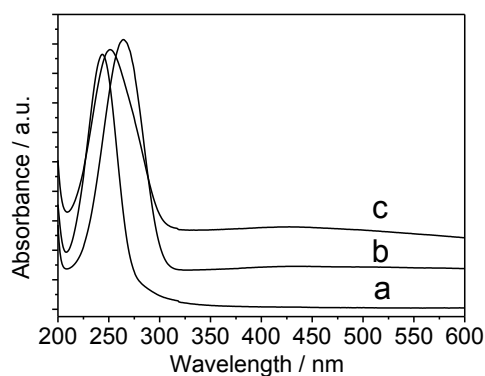


Figure S6. UV-Vis spectra of the Fe₃O₄@C-CDs NPs synthesized under different volume (mL)/mass(g) ratios of H₂O₂ solution/ferrocene at (a) 5, (b) 15, and (c) 25, respectively.

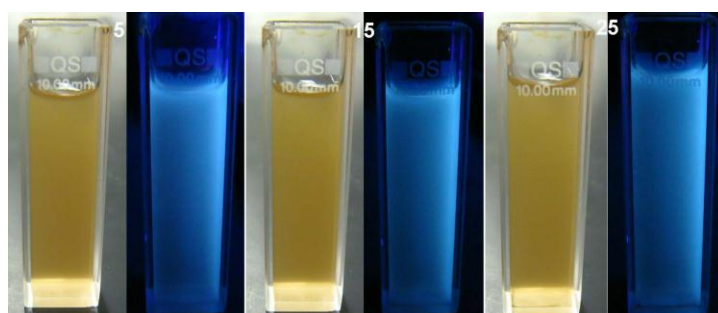


Figure S7. Photographs of the aqueous dispersions of the Fe₃O₄@C-CDs NPs synthesized under different volume(mL)/mass(g) ratios of H₂O₂ solution/ferrocene at (a) 5, (b) 15, and (c) 25, respectively, under visible light and UV light (365 nm).

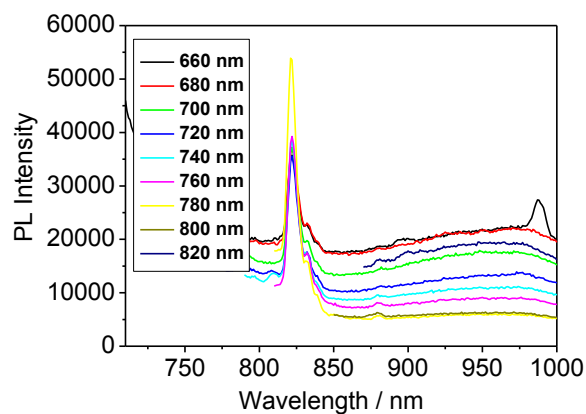


Figure S8. PL spectra of the Fe_3O_4 @C-CDs NPs suspension in the NIR range excited under different excitation wavelength.

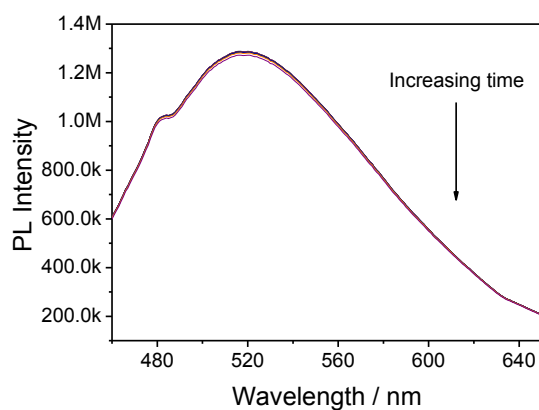


Figure S9. Time-dependent PL spectra ($\lambda_{\text{em}}=520$ nm) of Fe_3O_4 @C-CDs NPs upon a continuous exposure at excitation wavelength of 440 nm from 0 min to 120 min.

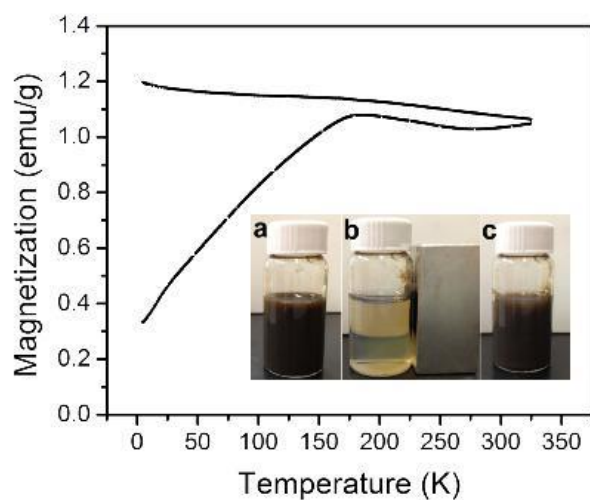


Figure S10. Zero-field-cooling (ZFC) and field-cooling (FC) curves of the $\text{Fe}_3\text{O}_4@\text{C}$ -CDs NPs measured in an applied field of 50 Oe. The inset shows the photographs of the aqueous dispersions of the hybrid NPs (a) without magnetic field, (b) with magnetic field for 1 min, and (c) after the removal of magnetic field.

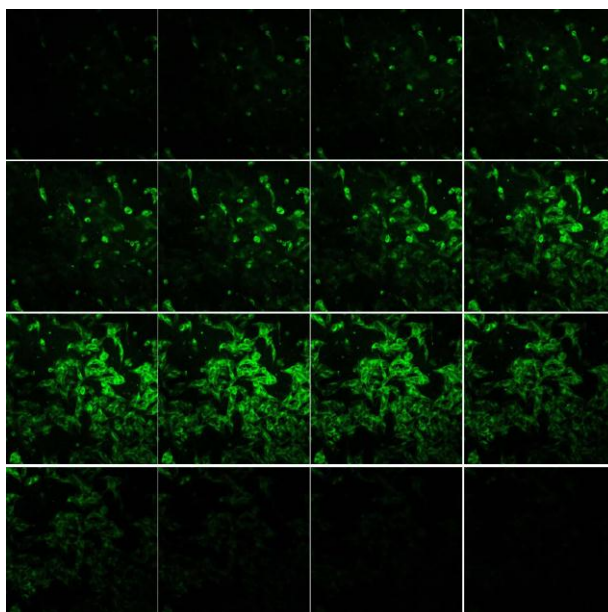


Figure S11. Top-down Z-Scanning confocal fluorescence images of the B16F10 cells incubated with the $\text{Fe}_3\text{O}_4@\text{C}$ -CDs NPs. Excitation wavelength = 488 nm.

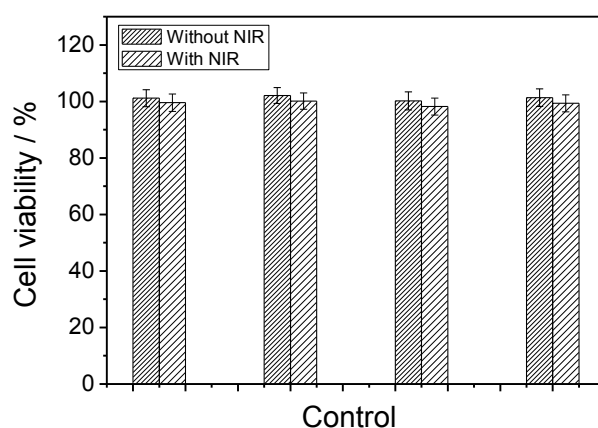


Figure S12. B16F10 cell viability in normal culture medium without hybrid NPs following the treatment with/without 5 min NIR light irradiation, respectively. The experiments were repeated four times.