

# 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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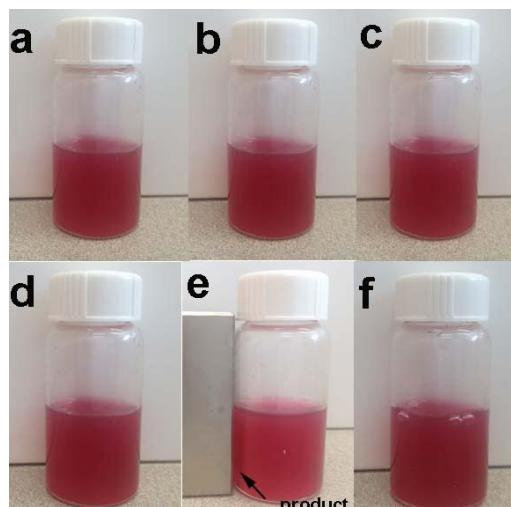


Figure S1. (Up) The photographs of the dispersions (0.2 mg/mL) of the  $\text{Fe}_3\text{O}_4@\text{C}$ -CDs hybrid NPs in cell culture medium with different storage time: (a) 0 day, (b) 3 days, and (c) 6 days. (Down) The photographs of the dispersions (0.2 mg/mL) of the hybrid NPs in culture medium (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.

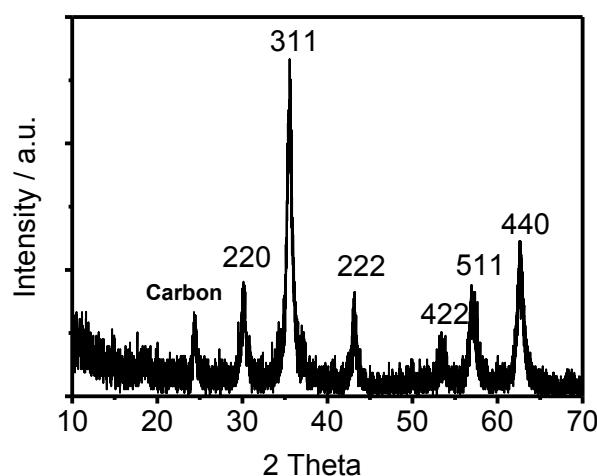


Figure S2. Typical XRD pattern of the as-obtained  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs.

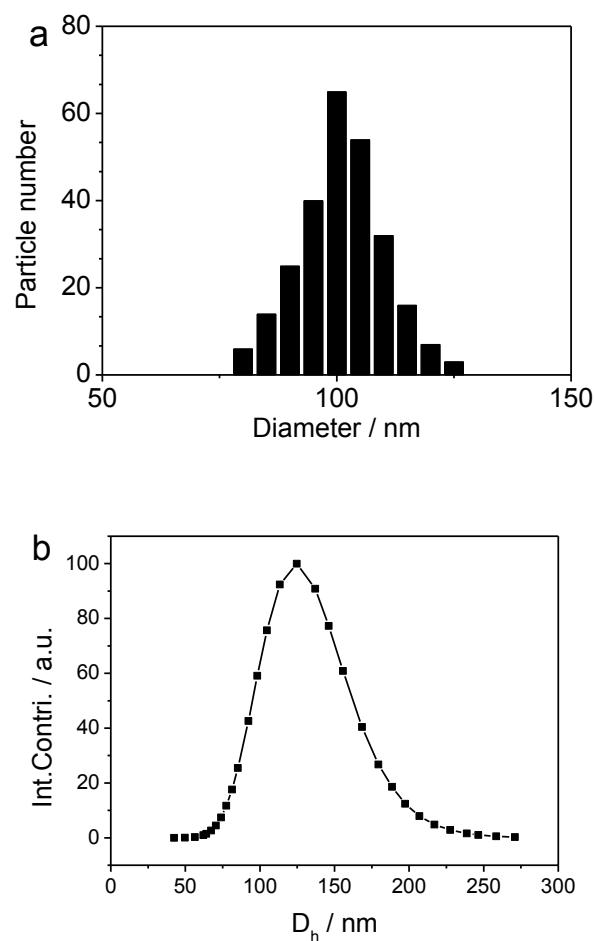


Figure S3. (a) Size distribution of the dried  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs on TEM images; (b) Hydrodynamic diameter distribution of the hybrid NPs dispersed in water obtained at a scattering angle  $\theta = 60^\circ$  and  $T = 22^\circ\text{C}$ .

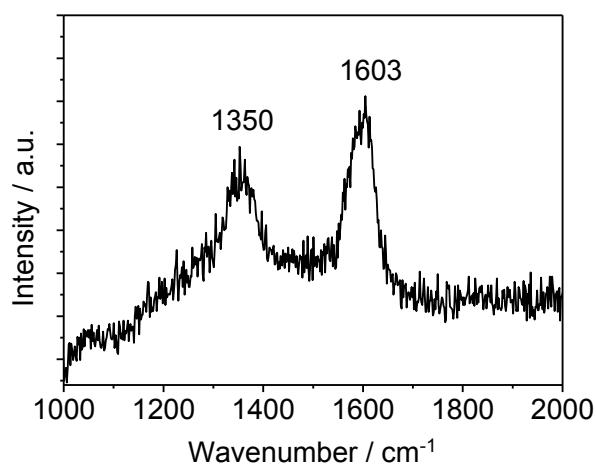


Figure S4. Typical Raman spectrum of the as-obtained  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs.

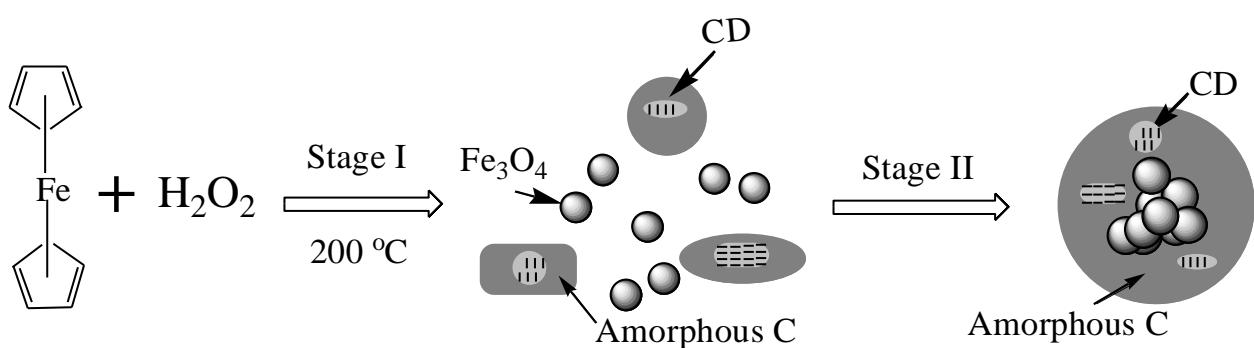


Figure S5. Schematic illustration of the formation of  $\text{Fe}_3\text{O}_4$ @C-CDs hybrid NPs.

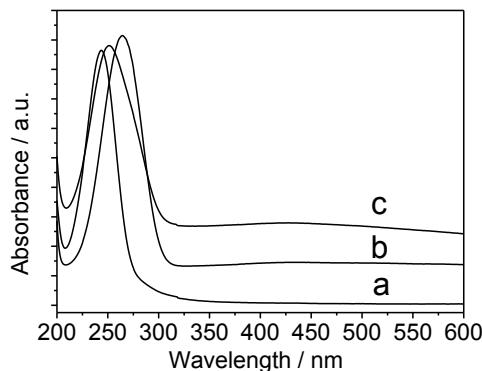


Figure S6. UV-Vis spectra of the  $\text{Fe}_3\text{O}_4$ @C-CDs NPs synthesized under different volume (mL)/mass(g) ratios of  $\text{H}_2\text{O}_2$  solution/ferrocene at (a) 5, (b) 15, and (c) 25, respectively.

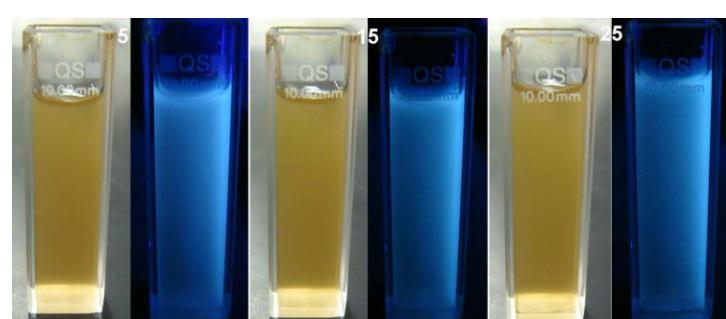


Figure S7. Photographs of the aqueous dispersions of the  $\text{Fe}_3\text{O}_4$ @C-CDs NPs synthesized under different volume(mL)/mass(g) ratios of  $\text{H}_2\text{O}_2$  solution/ferrocene at (a) 5, (b) 15, and (c) 25, respectively, under visible light and UV light (365 nm).

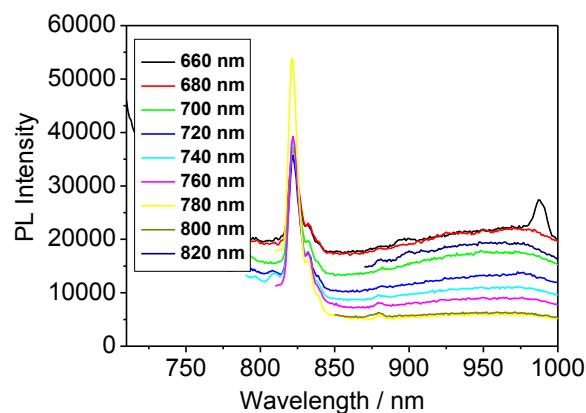


Figure S8. PL spectra of the  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs suspension in the NIR range excited under different excitation wavelength.

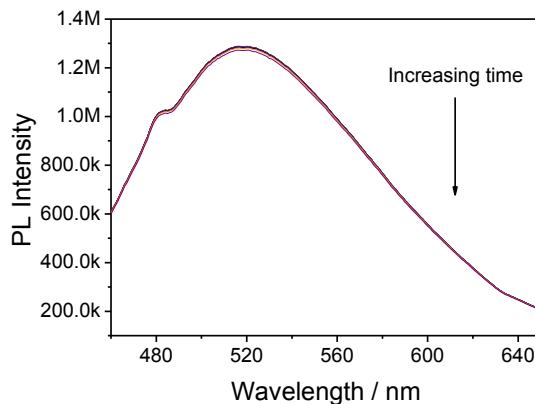


Figure S9. Time-dependent PL spectra ( $\lambda_{\text{em}}=520$  nm) of  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs upon a continuous exposure at excitation wavelength of 440 nm from 0 min to 120 min.

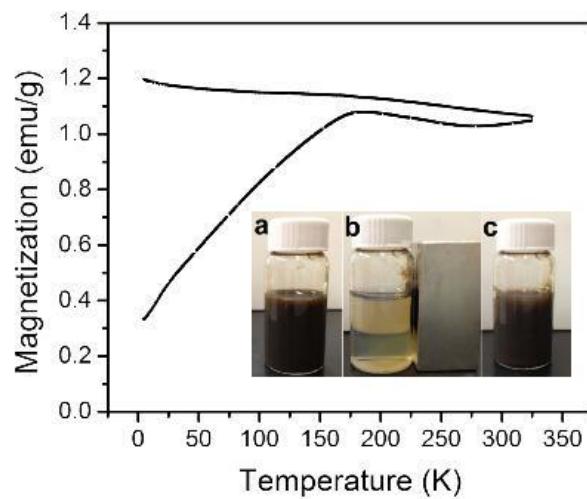


Figure S10. Zero-field-cooling (ZFC) and field-cooling (FC) curves of the  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs measured in an applied field of 50 Oe. The inset shows the photographs of the aqueous dispersions of the hybrid NPs (a) without magnetic field, (b) with magnetic field for 1 min, and (c)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

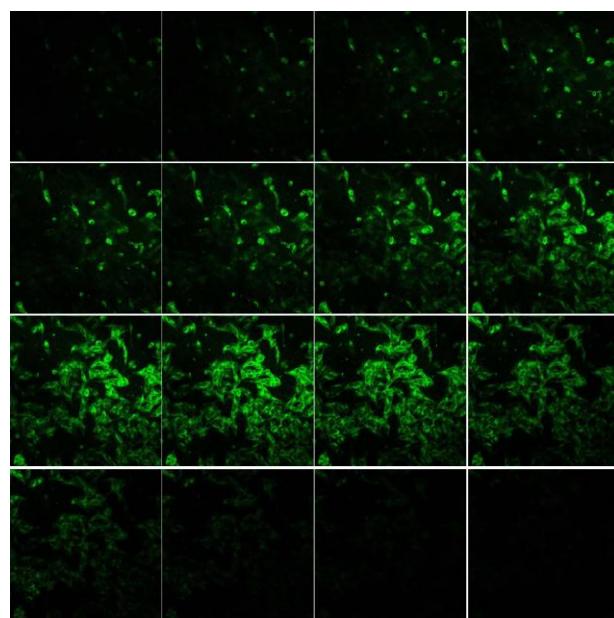


Figure S11. Top-down Z-Scanning confocal fluorescence images of the B16F10 cells incubated with the  $\text{Fe}_3\text{O}_4@\text{C-CDs}$  NPs. Excitation wavelength = 488 nm.

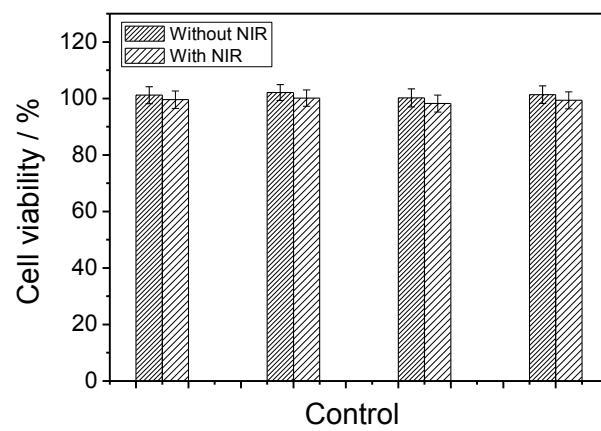


Figure S12. B16F10 cell viability in normal culture medium without hybrid NPs following the treatment with/without 5 min NIR light irradiation, respectively. The experiments were repeated four times.