Supporting Information

Orthogonal Adsorption of Carbon Dots and DNA on Nanoceria

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Methods of using gel permeation chromatographic for the separation of CDs. In brief, the crude CD products (dispersed in Milli-Q water) were passed through a column (stationary phase, silica 400 mesh) using water as an eluent to separate it based on the following conditions: mobile phase, water; flow rate, 2 mL·min^{-1}; injection volume, 100 mL.

Table S1 Detailed information about nanoceria, GO and AuNPs.

Nanomaterials	**Size**	**Morphology**	**Surface Ligand**	[a] **Maximum Absorption Wavelength**	[a] **Source of Information**
nanoceria	~ 5 nm	not well-defined shape	N/A	~290 nm	Reference 1
AuNPs	~13 nm	spherical	carboxyl and hydroxyl groups	520 nm	Reference 2
GO	1~5 μm	thin flake/film	carboxyl and hydroxyl groups	~235 nm	https://www.acsmaterial.com/

[a] The maximum absorption wavelengths of nanoceria, GO and AuNPs were obtained from Figure S8 below.

Reference 1: Pautler, R.; Kelly, E. Y.; Huang, P. J.; Cao, J.; Liu, B.; Liu, J., Attaching DNA to Nanoceria: Regulating Oxidase Activity and Fluorescence Quenching. ACS Appl. Mater. Interfaces 2013, 5, 6820-6825.

Reference 2: Liu, J.; Lu, Y., Preparation of Aptamer-Linked Gold Nanoparticle Purple Aggregates for Colorimetric Sensing of Analytes. Nat. Protoc. 2006, 1, 246-252.

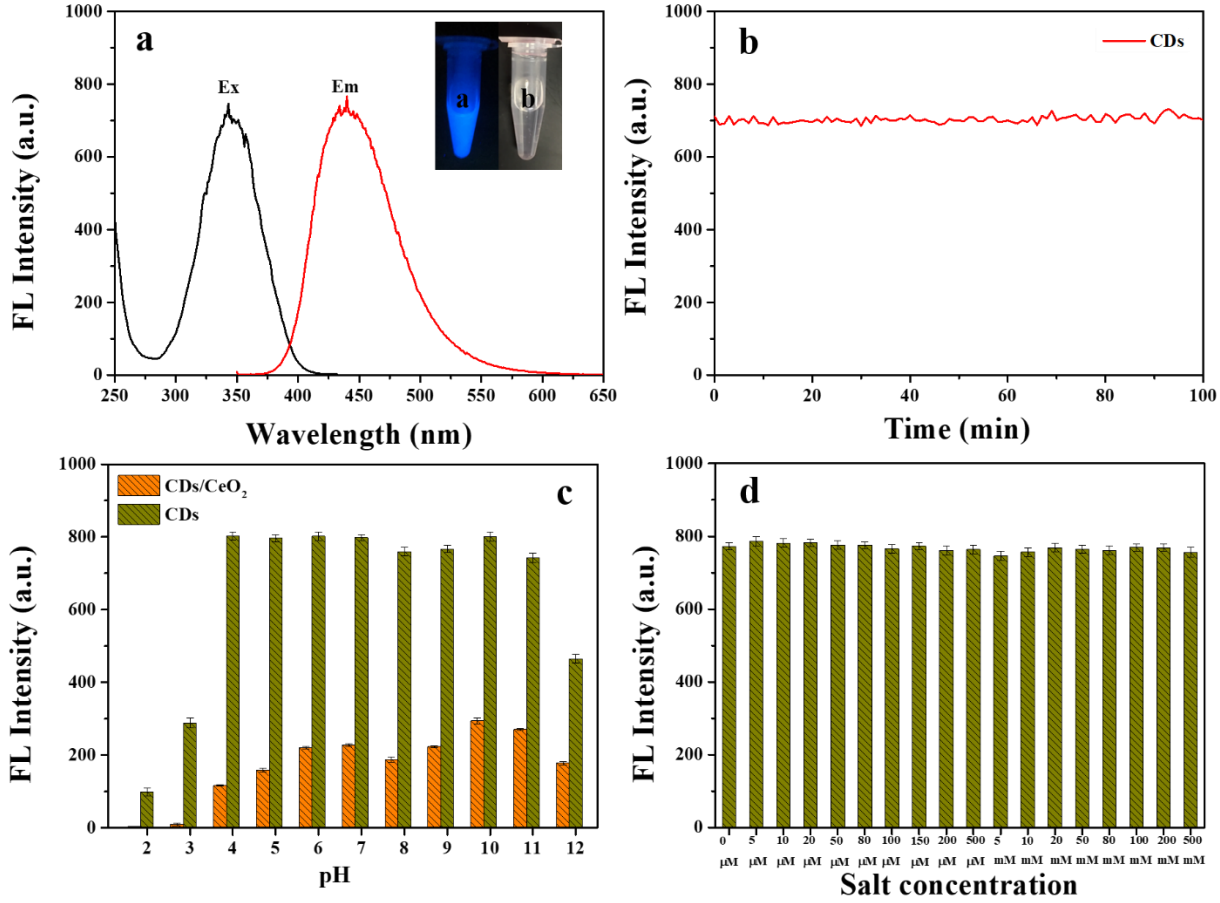

Figure S1 Characterization of the purified CDs. **(a)** The FL excitation (Ex) and emission (Em) spectra of the CDs, both excitation and emission slit width were 5 nm. Inset: Photographs of the CDs under an ultraviolet (UV) light (left) and a daylight lamp (right). **(b)** Photostability of the CDs under continuous irradiation for 100 min, excitation wavelength: 344 nm; emission wavelength: 440 nm. FL of the CDs (100 ng·mL^{-1}) and CDs mixed with CeO_2 (98 μg·mL^{-1}) (CD/CeO_2) at **(c)** different pH solutions and **(d)** different concentrations of salt (NaCl) calculated based on FL emission intensity at 440 nm.

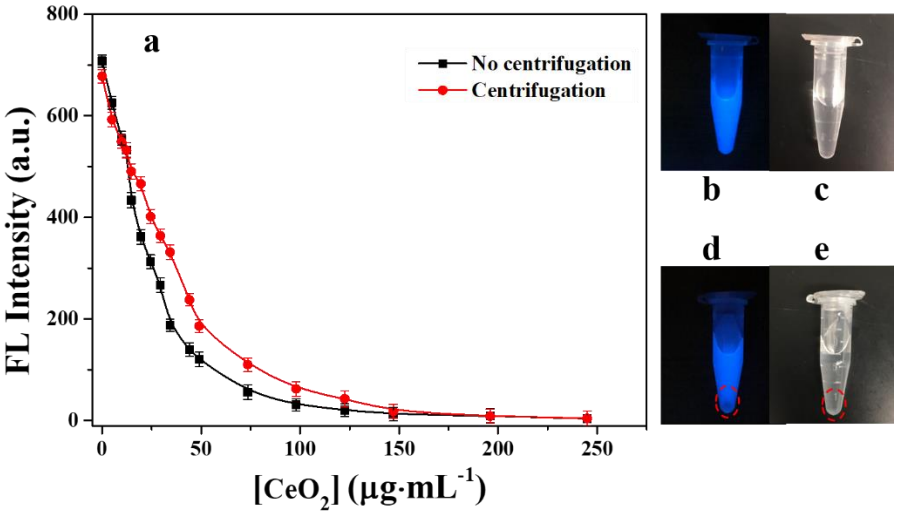

Figure S2 (a) FL quenching of the CDs as a function of concentration of CeO_2 NPs before (black) and after (red) centrifugation, calculated by the FL emission intensity at 440 nm; excited at 344 nm. Photographs of the CDs mixed with the CeO_2 NPs (20 μg·mL^{-1}) under an UV light **(b)** and a daylight lamp **(c)** before centrifugation. CDs mixed with CeO_2 NPs (20 μg·mL^{-1}) under an UV light (365 nm) **(d)** and a daylight lamp **(e)** after centrifugation. The pellets are highlighted.

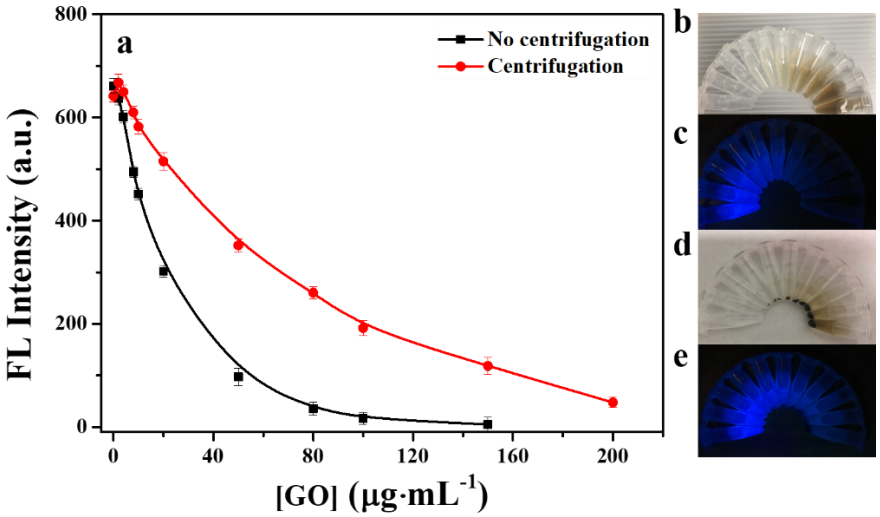

Figure S3 (a) FL quenching of CDs as a function of concentration of GO before (black) and after (red) centrifugation, calculated by FL emission intensity at 440 nm; excited at 344 nm. The CDs mixed with different concentrations GO under a daylight lamp **(b)** and an UV light **(c)** before centrifugation. CDs mixed with different concentrations GO under a daylight lamp **(d)** and an UV light (365 nm) **(e)** after centrifugation.

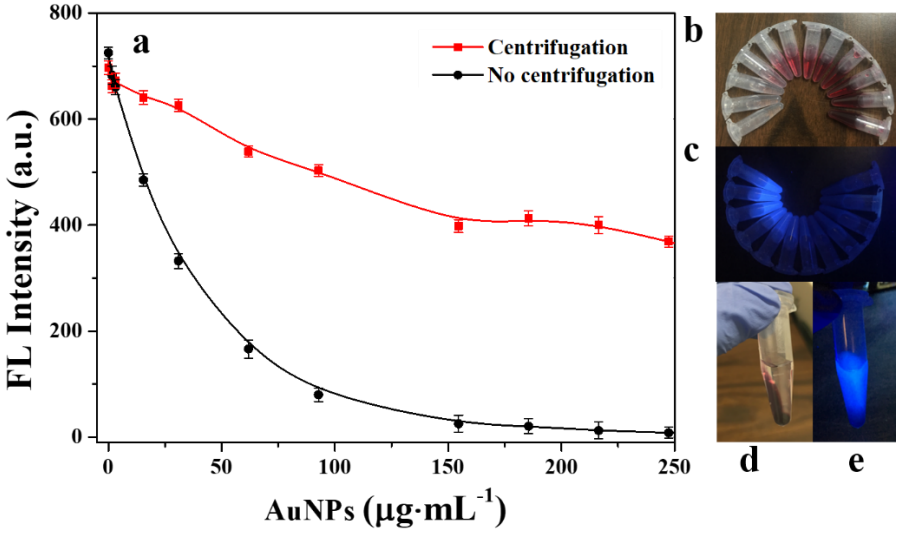

Figure S4 (a) FL quenching of CDs as a function of concentration of AuNPs before (black) and after (red) centrifugation, calculated by FL emission intensity at 440 nm; excited at 344 nm. The CDs mixed with different concentrations AuNPs under a daylight lamp **(b)** and an UV light (365 nm) **(c)** before centrifugation. CDs mixed with AuNPs (100 μg·mL^{-1}) under a daylight lamp **(d)** and an UV light **(e)** after centrifugation.

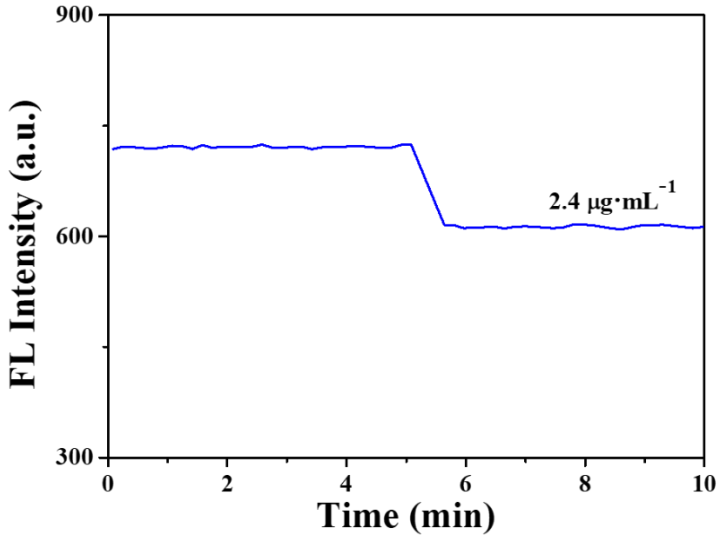

Figure S5 Adsorption kinetics of the CDs on nanoceria when the concentration of nanoceria was 2.4 μg·mL^{-1}.

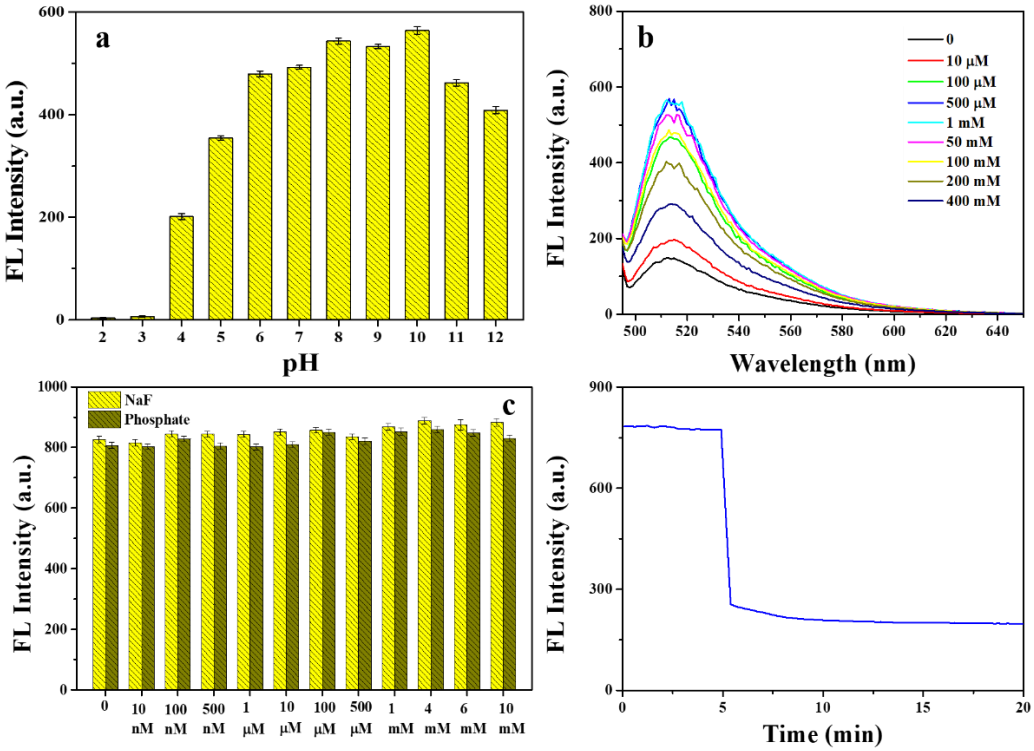

Figure S6 (a) FL of the calcein at different pH solutions, calculated by FL emission intensity at 512 nm; **(b)** FL spectra of the calcein (1.5 μM) in different concentrations of HEPES (pH 7.4); excited at 490 nm, both excitation and emission slit width were 5 nm. The optimum concentration of HEPES was 1 mM. **(c)** FL of the calcein (1.5 μM) in different concentrations of NaF or phosphate in HEPES buffer (pH 7.4, 1 mM). **(d)** Adsorption kinetics of calcein (1.5 μM) on nanoceria (4.9 μg·m L^{-1}).

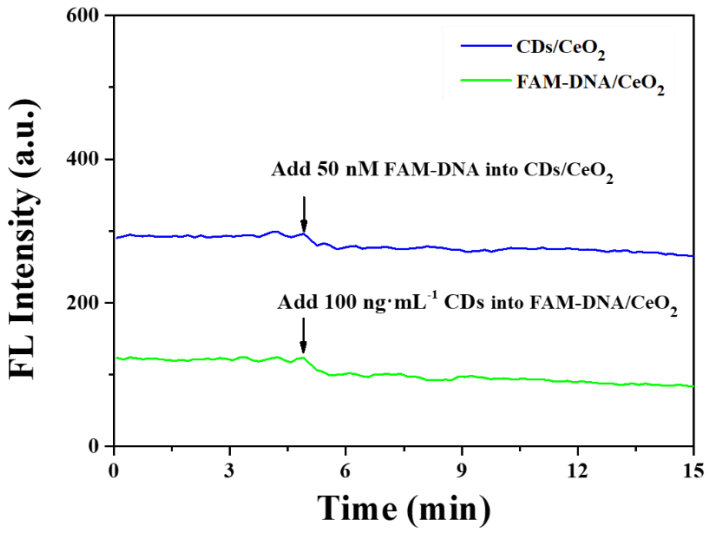

Figure S7 Kinetics of FL indicative of interaction effect of FAM-DNA to CDs/CeO_2 (50 μg·mL^{-1}) mixtures by adding FAM-DNA into CDs/CeO_2 mixtures (blue). Kinetics of FL indicative of interaction effect of CDs to FAM-DNA/CeO_2 (2.5 μg·mL^{-1}) mixtures by adding CDs into FAM-DNA/CeO_2 mixtures (green). The concentrations of CDs in CDs/CeO_2 and FAM-DNA in FAM-DNA/CeO_2 were 100 ng·mL^{-1} and 50 nM, respectively.

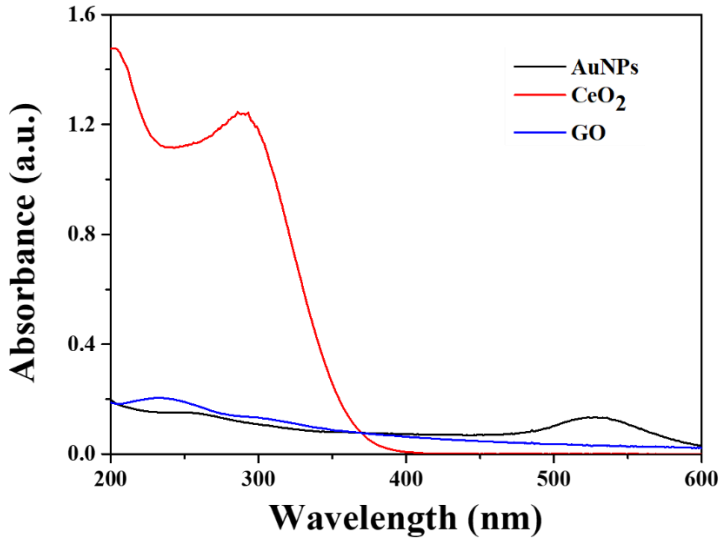

Figure S8 UV-vis absorption spectra of nanoceria (1 μg·mL^{-1}), GO (0.1 μg·mL^{-1}) and AuNPs (0.1 μg·mL^{-1}).