Supporting Information

Regulating Carrier Dynamics in CdS via Controlled Sulfur Vacancy Engineering: Insights from Femtosecond Transient Absorption Spectroscopy

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Experimental section

Materials characterizations

X-ray diffraction (XRD) patterns were recorded using an X-ray diffractometer (XRD-6100, λ = 0.15 nm, Shimadzu, Japan). Field-emission scanning electron microscopy (FESEM) imaging was obtained on a Regulus 8100 microscope. Transmission electron microscopy (TEM) together with energy-dispersive X-ray spectroscopy (EDS) was performed on a Thermo Fisher Talos F200X transmission electron microscope. Electron paramagnetic resonance (EPR, EMX nano, Bruker) spectroscopy was used to detect the paramagnetic signals associated with sulfur vacancies. X-ray photoelectron spectroscopy (XPS) measurements were conducted using a Thermo Scientific ESCALA 210 XPS system (USA) equipped with Al Kα radiation (300 W). UV-vis diffuse reflectance spectra were collected on a Shimadzu UV2600 UV-visible spectrometer. Steady-state photoluminescence (PL) spectra were measured on a fluorescence spectrophotometer (F-7000, Hitachi, Japan) under an excitation wavelength of 400 nm. The contact potential difference (V_{CPD}) was characterized by Kelvin probe force microscopy (KPFM) using a Bruker MultiMode 8 system. The KPFM measurements were conducted under ambient air, with a dehumidifier used to maintain relative humidity below 50%. A 365 nm LED with an illumination intensity of 5.5 mW/cm^2 served as the light source.

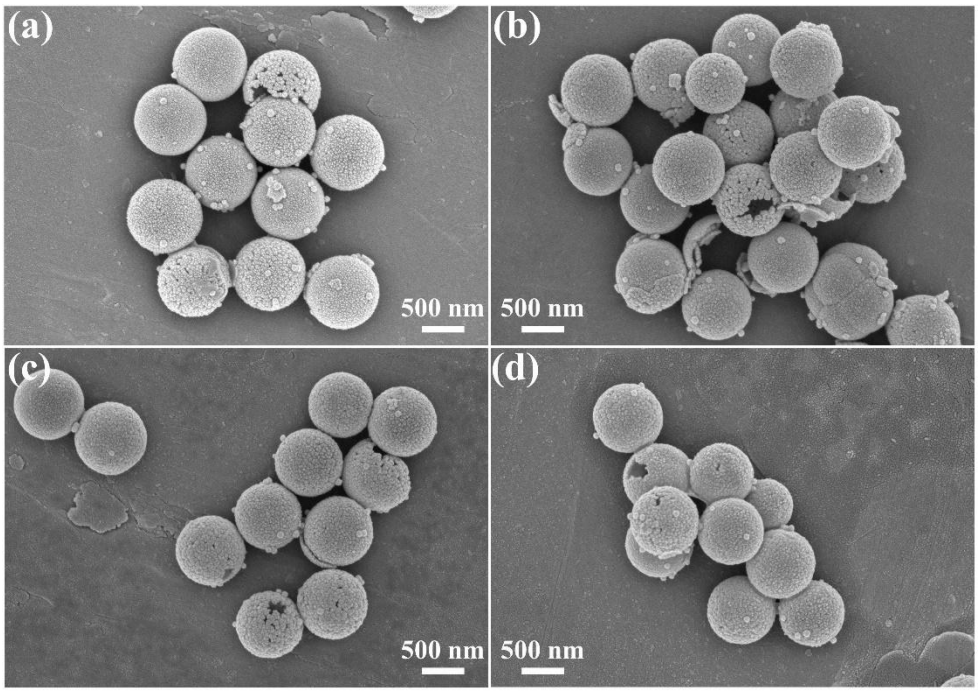


Fig. S1. CdS hollow spheres (HS) obtained by calcination at different temperatures: (a) uncalcined, (b) 300 °C, (c) 500 °C, and (d) 700 °C.

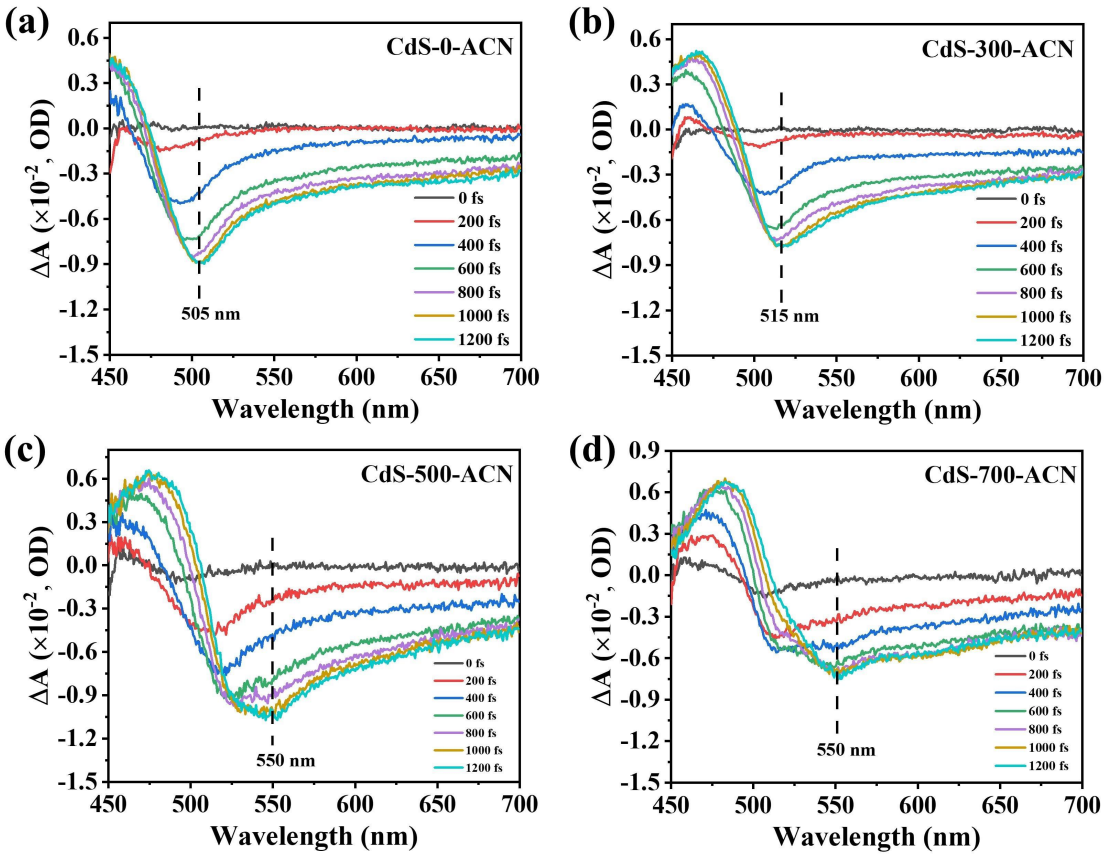


Fig. S2. fs-TA excitation spectra of CdS-0, CdS-300, CdS-500, and CdS-700 in acetonitrile (ACN).

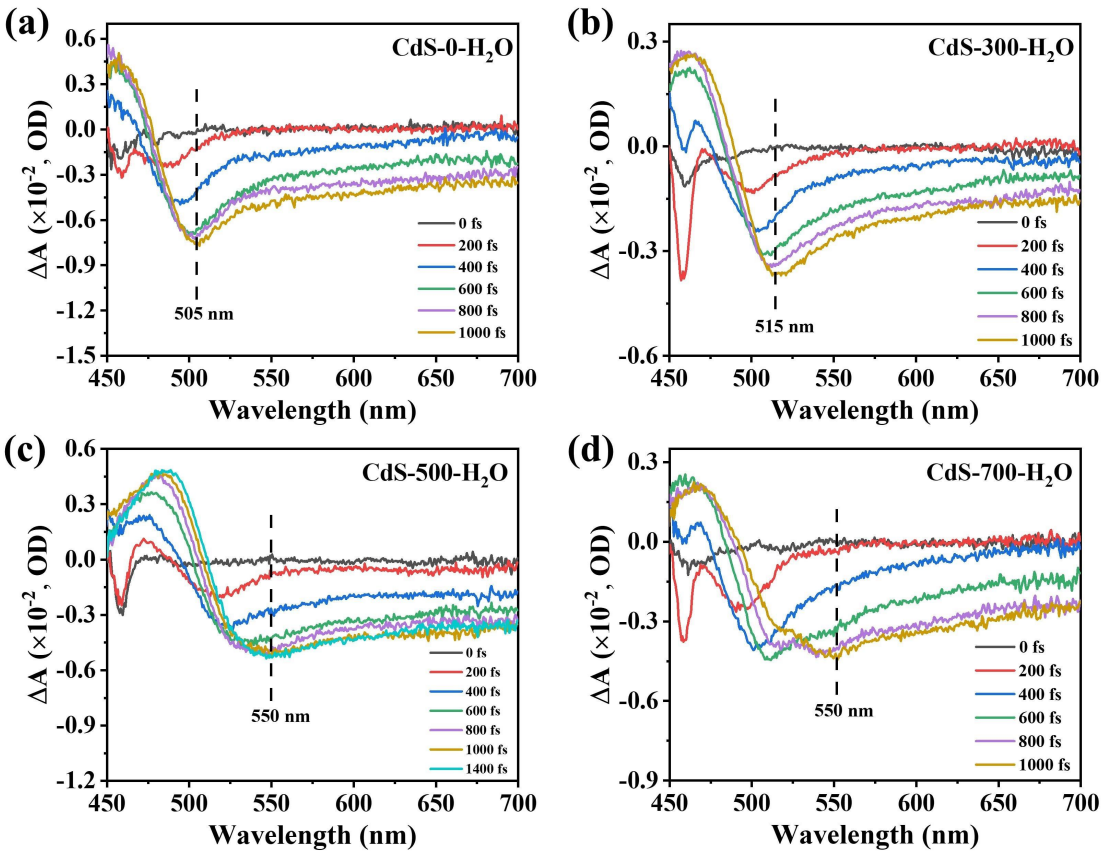


Fig. S3. fs-TA excitation spectra of CdS-0, CdS-300, CdS-500, and CdS-700 in water.

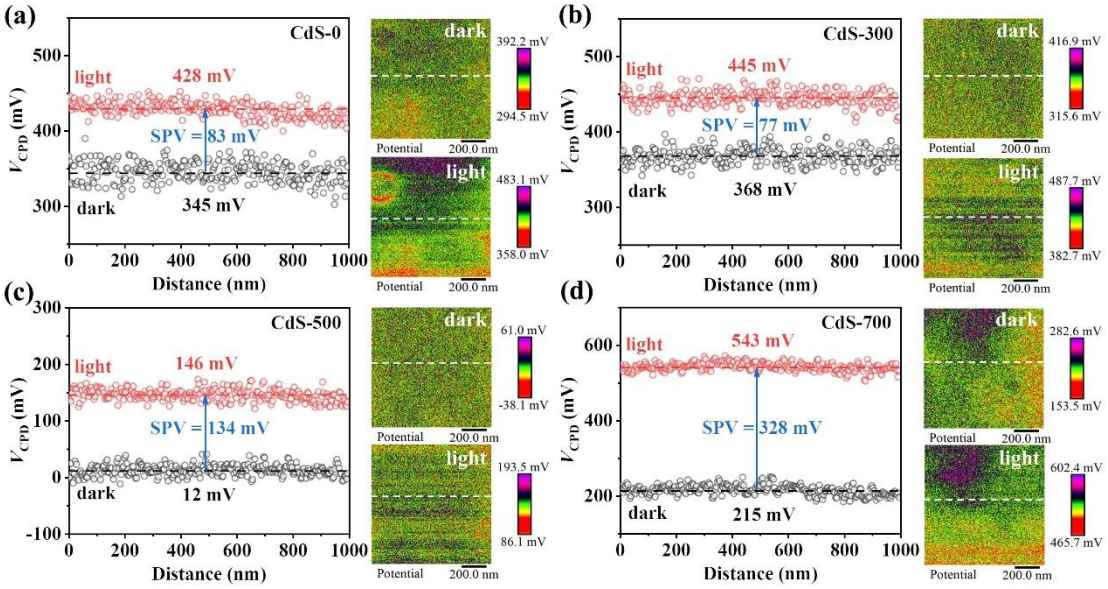


Fig. S4. The contact potential difference (V_{CPD}) values of CdS-0, CdS-300, CdS-500, and CdS-700 under dark and illuminated conditions.