Electronic supplementary information (ESI) available

Carbon Quantum Dots Embedded with Mesoporous Hematite Nanospheres as Efficient Visible Light-active Photocatalysts

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**Table S1.** FWHM values of the main diffraction peaks and the crystallite size for mesoporous hematite with the respective diffraction planes.

<table>
<thead>
<tr>
<th>h</th>
<th>k</th>
<th>l</th>
<th>2θ (deg.)</th>
<th>d-spacing (nm)</th>
<th>Intensity (a.u.)</th>
<th>FWHM (2θ)</th>
<th>Crystallite size (nm)</th>
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Fig. S1 Chemical structure of CQD.
**Fig. S2** CQDs optical image in water illuminated under (a) white (left; CQDs in water, right; water) and (b) UV light (left; CQDs in water, right; water).
Fig. S3 Photograph of mesoporous magnetite and hematite powders.
Fig. S4 FT-IR spectrum of (a) MH, (b) CQD, and (C) CQD/MH.
**Fig. S5** FE-SEM images of (a) MH, and (b) CQD/MH (a more detailed view).
Fig. S6 TEM images of CQD/MH hybrid clusters.
Fig. S7 The intensity auto-correlation function (ACF), $G_2(\tau)$ for CQD/MH sample in DLS.

The second-order correlation function $G_2(\tau)$ can be expressed as a function of the first-order correlation function $G_1(\tau)$ according to the Siegert relation: $G_2(\tau) = B(1 + \beta G_1(\tau)^2)$, where $B$ is the baseline constant and $\beta$ is a coherence constant. In the case of a perfect setup, both equal unity. In the case of single-exponential decay, $G_1(\tau)$ can be expressed in terms of a typical decay rate $\Gamma$ and time $t$: $G_1(\tau) = \exp(-\Gamma \tau)$. The apparent translational diffusion coefficient, $D$, is given by equation: $\Gamma = Dq^2$, where $q$ is the magnitude of the scattering vector $q = 4\pi n \sin(\theta/2)/\lambda$, where $n$ is the refractive index of the solvent, $\theta$ is the scattering angle, and $\lambda$ is the wavelength of the incident light. For spherical particles, the translational diffusion coefficient can be related to the hydrodynamic radius, $R$, according to the Stokes-Einstein equation: $D = k_B T / 6\pi \eta R$, where $D$ is the diffusion coefficient of the Brownian motion of spherical particles, $k_B$ is the Boltzmann constant, $T$ is the absolute temperature, and $\eta$ is the viscosity of the solvent. The hydrodynamic radius distribution of
particles, $G(R)$ was estimated using the COTIN algorithm, which is conventionally used to determine the inverse Laplace transform of the measured amplitude autocorrelation function.$^{1,2}$


Fig. S8 UV-visible spectra of the MH and CQD/MH.
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**Figure a**

Absorbance vs. Wavelength (nm) for samples at different times: 0 min, 5 min, 10 min, 20 min, 30 min, 60 min, and 90 min.

**Figure b**

Absorbance vs. Wavelength (nm) for samples at different times: 0 min, 5 min, 10 min, 20 min, 30 min, 60 min, and 90 min.
Fig. S9 Absorption spectra of MB solution taken at different photocatalytic degradation times using (a) MH, (b) MH+H₂O₂ and (c) CQD/MH.
**Fig. S10** Decolorization profiles of MB aqueous solution with visible light irradiation in the presence of the CQD/MH+H₂O₂.
**Fig. S11** Schematic illustration of possible catalytic mechanism for CQD/MH under visible light.