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Electronic Supplementary Information

The Regulation of Hydrophilicity and Hydrophobicity of Carbon Dots via One-pot Approach

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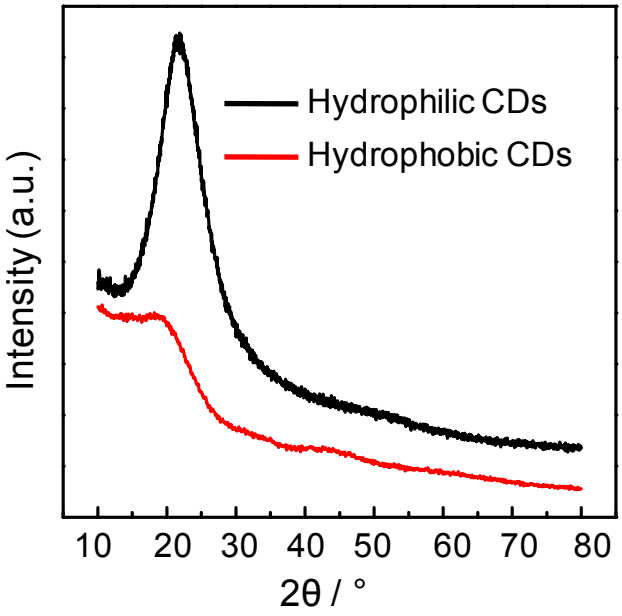

Figure S1. XRD patterns of the hydrophilic CDs (black line) and hydrophobic CDs (red line).

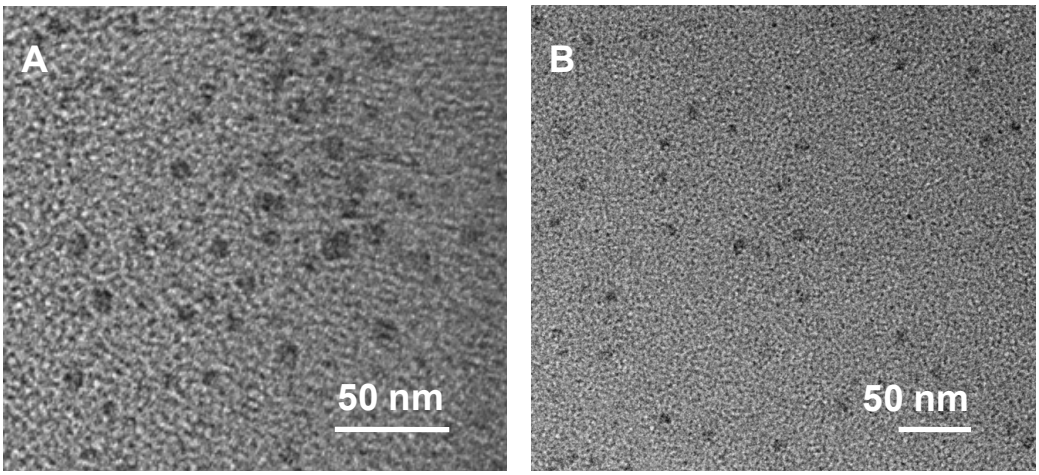

Figure S2. TEM images of hydrophilic CDs (A) and hydrophobic CDs (B).

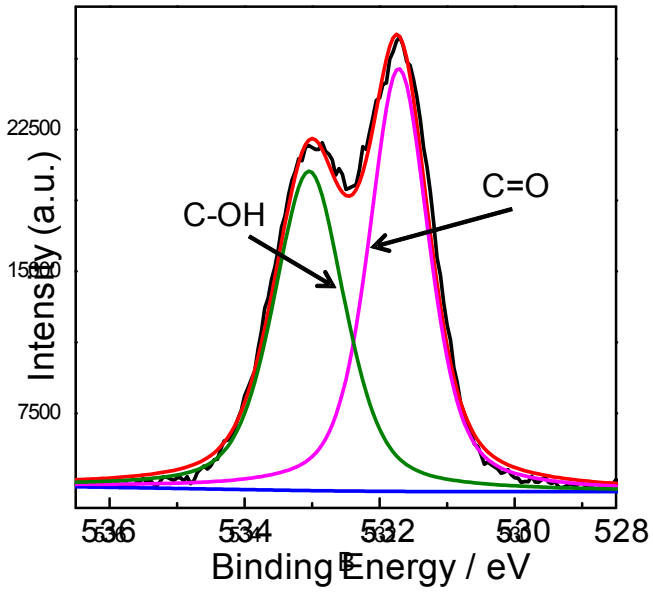

Figure S3. High resolution XPS spectrum of O1s in the hydrophilic CDs. The peak at 531.7 eV and 533.0 eV are attributed to C=O bond and C-OH bond, respectively.

The quantification of quantum yields

The quantum yield (Φ) of hydrophilic CDs is calculated by comparing with the integrated photoluminescence and absorbance values with that of quinine sulfate. The quinine sulfate (quantum yield reported in the literature Φ = 0.54)[1] is dissolved in 0.1 mol L^{-1} H_2SO_4 (refractive index of η 1.33) and the hydrophilic CDs is dissolved in ultra pure water (η 1.33).

The quantum yield (Φ_2) of hydrophobic CDs is calculated in the same way by comparing with fluorescein. The fluorescein (quantum yield reported in the literature Φ = 0.95)[2] is dissolved in 0.1 mol L^{-1} NaOH (refractive index of η 1.33) and the hydrophobic CDs is dissolved in ethanol (η 1.36).

The experimental data are listed in Table S1 and Table S2. The quantum yields are calculated by using the following equation:

$$\Phi_s = \Phi_r \times (S_s / S_r) \times (A_r / A_s) \times (\eta_s / \eta_r)^2$$

Where Φ is the quantum yield, S is the integrated area, A is the absorbance, η is the refractive index of the solvent, s stands for the sample and r stands for the reference.

Table S1. The corresponding data concerning the quantification of quantum yield for the hydrophilic CDs.

Sample	Absorbance (350 nm)	Integrated area (361-600nm)	η	Φ
Quinine Sulfate	0.051	371734.16	1.33	0.54
Hydrophilic CDs	0.038	85513.24	1.33	0.17

Table S2. The corresponding data concerning the quantification of quantum yield for the hydrophobic CDs.

Sample	Absorbance (465 nm)	Integrated area (476-630nm)	η	Φ
Fluorescein	0.041	360610.16	1.33	0.95
Hydrophobic CNPs	0.042	28701.44	1.36	0.077

Reference:

1. S. L. Hu, K. Y. Niu, J. Sun, J. Yang, N. Q. Zhao, X. W. Du, *J. Mater. Chem.*, 2009, **19**, 484.

2. S. K. Bhunia, A. Saha, A. R. Maity, S. C. Ray, N. R. Jana, *Sci. Rep-UK*, 2013, **3**, 1473.

The proportions of hydrophilic and hydrophobic CDs achieved by regulating the H_3PO_4/ethanol molar ratio

H_3PO_4/ethanol mixture solution with different molar ratios is used to mix with $BmimPF_6$ for the preparation of hydrophilic and/or hydrophobic CDs. The obtained CDs are treated as described in *Experimental section 2.3*. The product is dried in a vacuum oven at 50 °C for 12 h. Afterwards the amount of CDs is measured by using an electronic balance. The corresponding information is summarized in Table S3.

Table S3. The proportions of hydrophilic and hydrophobic CDs achieved by varying the H_3PO_4/ethanol molar ratio.

H_3PO_4/ethanol molar ratio	Ethanol only	0.012	0.030	0.062	0.43	0.85	1.72	H_3PO_4 only	H_3PO_4 and ethanol free
H_3PO_4 concn. (mol L^{-1})	0	0.20	0.50	1.0	5.0	7.3	10.0	5.0/14.6	0
Ethanol concn. (mol L^{-1})	17.1	16.9	16.6	16.0	11.5	8.54	5.80	0	0
$BmimPF_6$ concn. (mol L^{-1})	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40/2.40	4.80
Hydrophilic CDs (gram)	2.24	2.48	3.06	3.06	3.23	2.91	2.79	3.71/0.52	0
Hydrophobic CDs (gram)	0.86	0.56	0.37	0.33	0.32	0.19	0.18	0/0	3.27
Total mass of CDs (gram)	3.10	3.04	3.43	3.39	3.55	3.10	2.97	3.71/0.52	3.27

It is seen that more hydrophilic CDs is produced with the increase of H_3PO_4/ethanol molar ratio up to 0.43, and then the mass of hydrophilic CDs is declined. At the same time, the mass of hydrophobic CDs decreases with the increase of H_3PO_4/ethanol molar ratio in the whole range studied. As discussed in the text (*Section 3.3*), H_3PO_4 promotes the decomposition of $Bmim^+$ serving as the carbon source and PF_6^- offering CDs hydrophobicity. More $Bmim^+$ and PF_6^- moieties are decomposed with the increase of H_3PO_4 concentration, giving rise to the increase of hydrophilic CDs and the decrease of hydrophobic CDs. However, $BmimPF_6$ is partially carbonized in the presence of high concentration of H_3PO_4, e.g., 10 mol L^{-1} and 14.6 mol L^{-1}, which leads to the decease of the total amount of CDs.

When the ethanol-only system is adopted, both hydrophilic and hydrophobic CDs are harvested. We have found that after hydrothermal treatment of the ethanol-only system PF_6^- is partially decomposed and HF is released, which makes it feasible to form both hydrophilic and hydrophobic CDs in the absence of H_3PO_4.

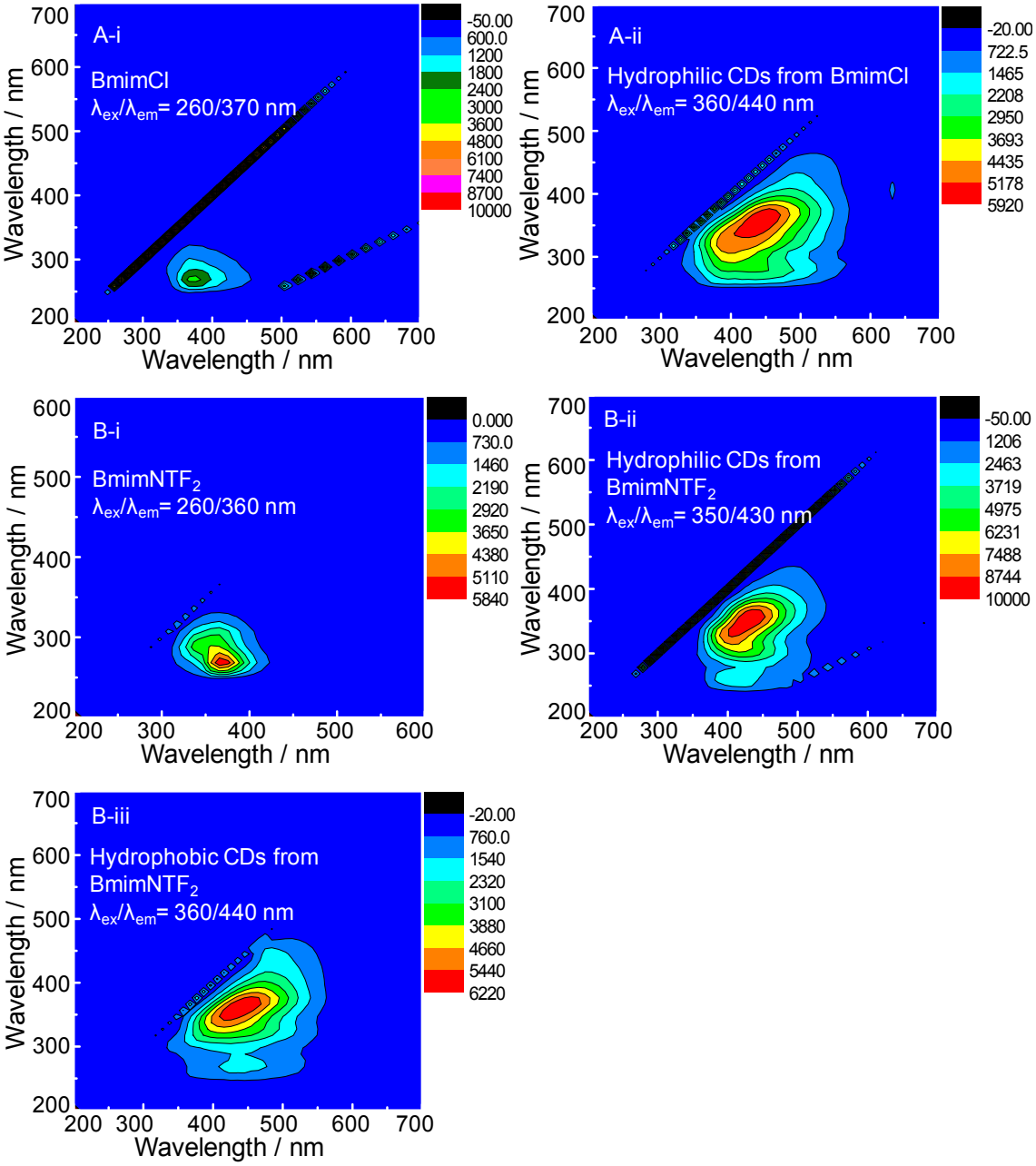

Figure S4. Fluorescent properties of BmimCl (A-i), hydrophilic CDs (A-ii) generated with BmimCl as carbon source; $BmimNTF_2$ (B-i), hydrophilic CDs (B-ii) and hydrophobic CDs (B-iii) generated with $BmimNTF_2$ as carbon source. The hydrophilic CDs are dispersed in water and the hydrophobic CDs are dispersed in ethanol.

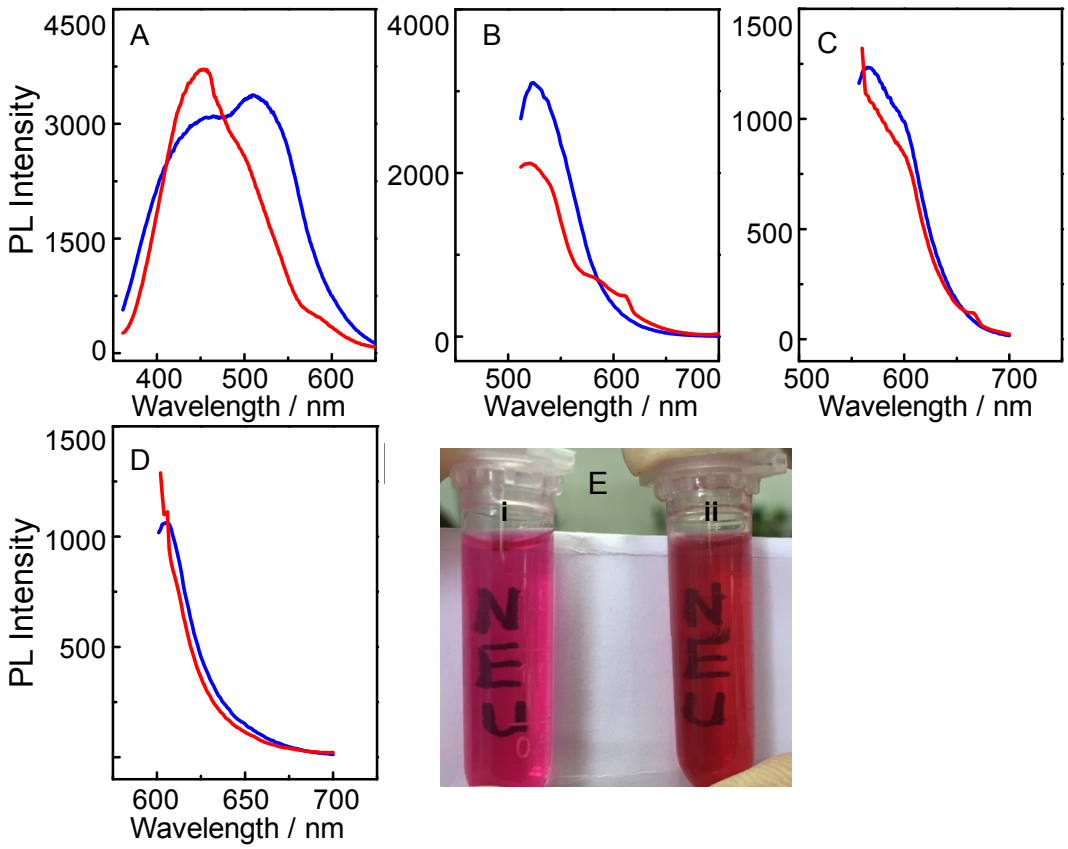

Figure S5. Fluorescent spectra of hydrophobic CDs (0.75 mg mL^{-1}) dispersed in ethanol (blue lines) and culture medium (red lines). Excitation wavelength is 340 nm (A), 495 nm (B), 550nm (C), 595 nm (D). E is the photo of the culture medium (i) and hydrophobic CDs dispersed in culture medium (ii).