Supporting information

Quaternized Carbon Dots as Efficient Catalysts for CO_2 Cycloaddition under Solvent- and Cocatalyst-free Conditions

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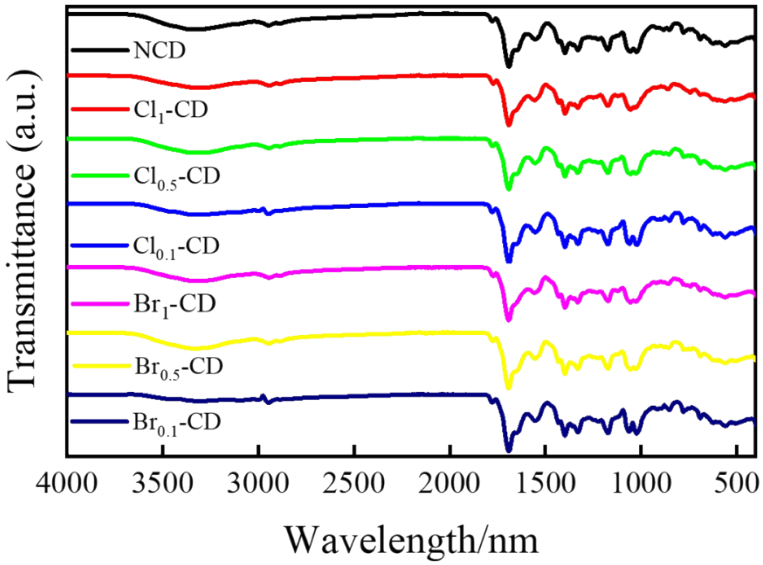

Figure S1 FT-IR spectra of NCD, Br_1-CD, $Br_{0.5}$-CD, $Br_{0.1}$-CD, Cl_1-CD, $Cl_{0.5}$-CD, and $Cl_{0.1}$-CD

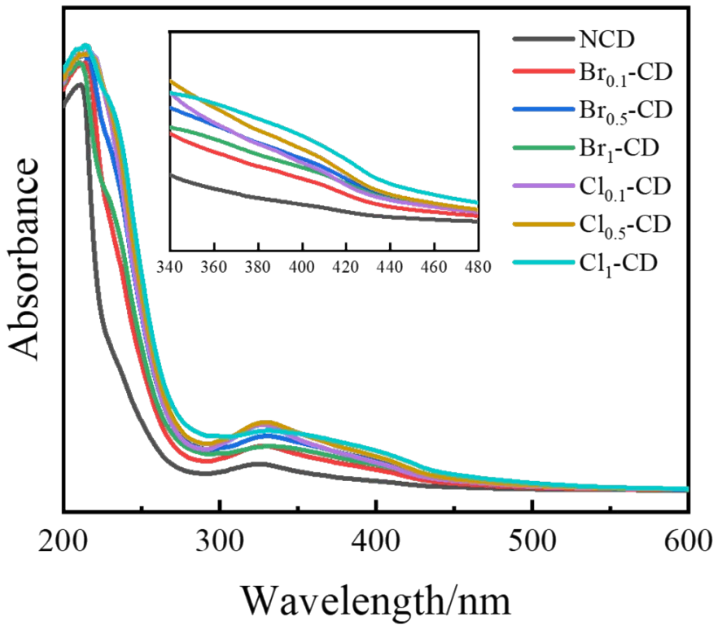

Figure S2 UV−vis spectra of NCD, Br_1-CD, $Br_{0.5}$-CD, $Br_{0.1}$-CD, Cl_1-CD, $Cl_{0.5}$-CD, and $Cl_{0.1}$-CD

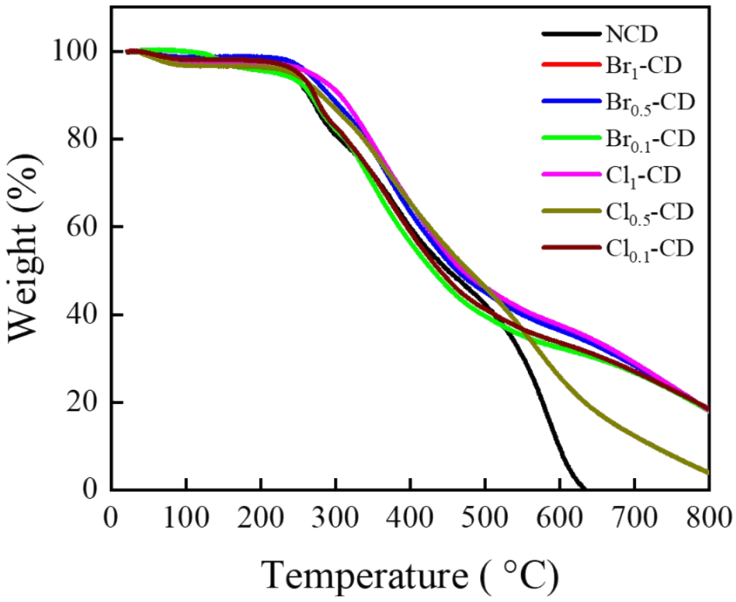

Figure S3 Thermogravimetric analysis (TGA) for NCD, Br_1-CD, $Br_{0.5}$-CD, $Br_{0.1}$-CD, Cl_1-CD, $Cl_{0.5}$-CD, and $Cl_{0.1}$-CD

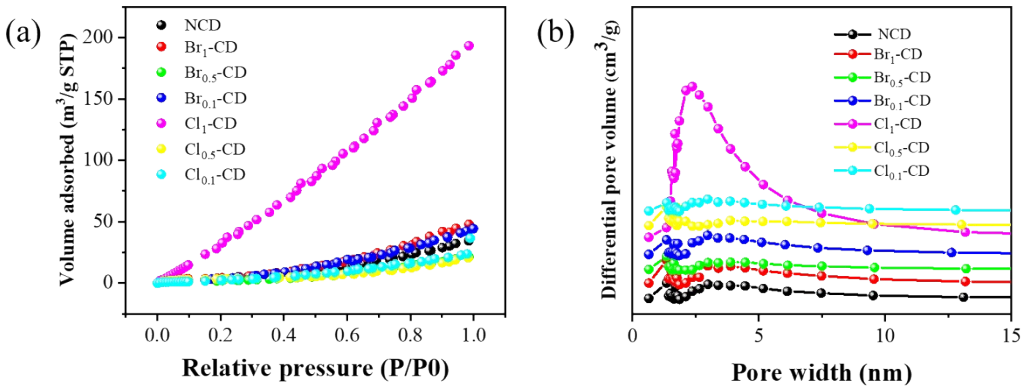

Figure S4 N_2 adsorption-desorption isotherms (a) and pore size distributions (b) of CDs

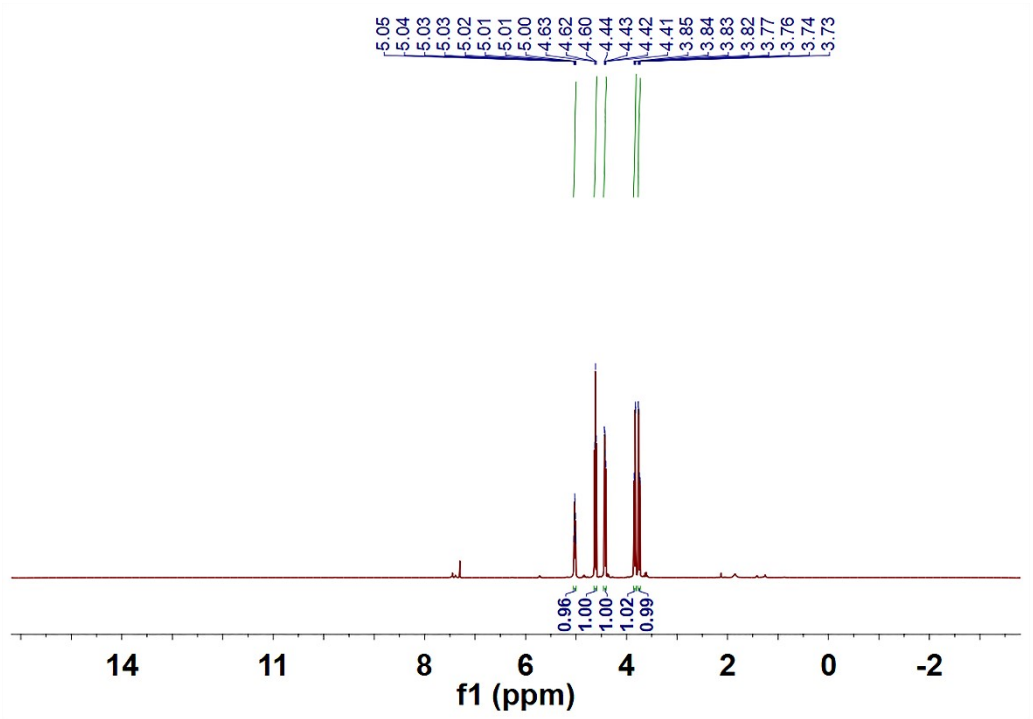

Figure S5 ^{1}H NMR spectrum of 4-(chloromethyl)-1,3-dioxolan-2-one

^{1}H NMR (500 MHz, $CDCl_3$) δ 5.02 (ddd, J = 14.2, 5.4, 3.6 Hz, 1H), 4.62 (t, J = 8.6 Hz, 1H), 4.42 (dd, J = 8.9, 5.7 Hz, 1H), 3.83 (dd, J = 12.2, 5.1 Hz, 1H), 3.75 (dd, J = 12.2, 3.6 Hz, 1H).

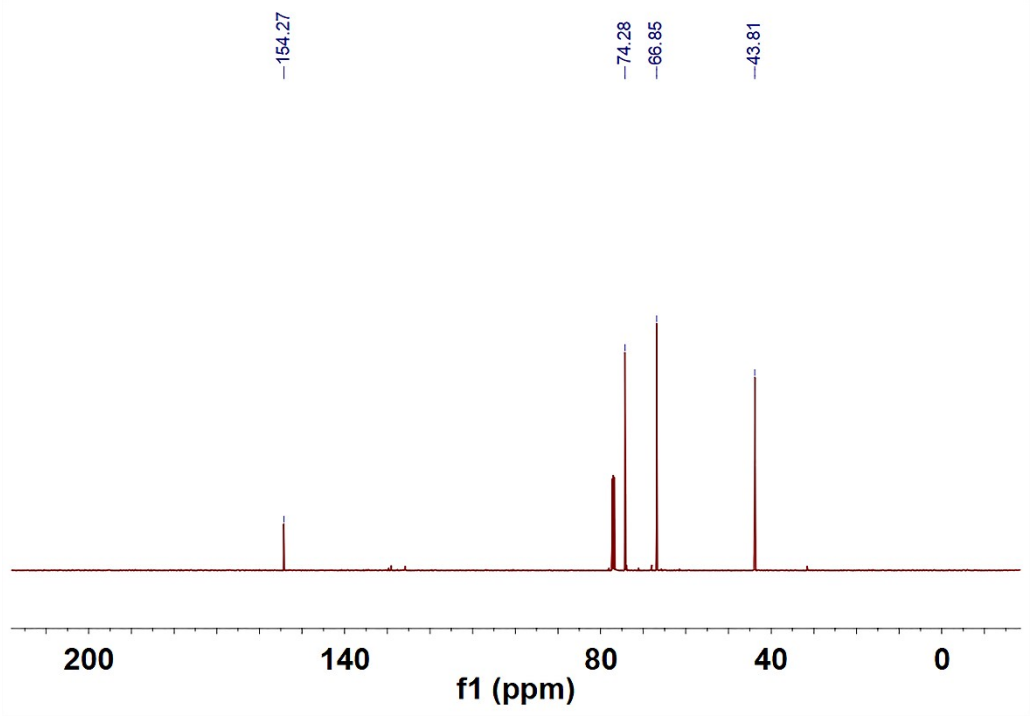

Figure S6 ^{13}C NMR spectrum of 4-(chloromethyl)-1,3-dioxolan-2-one

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.27 (s), 74.28 (s), 66.85 (s), 43.81 (s).

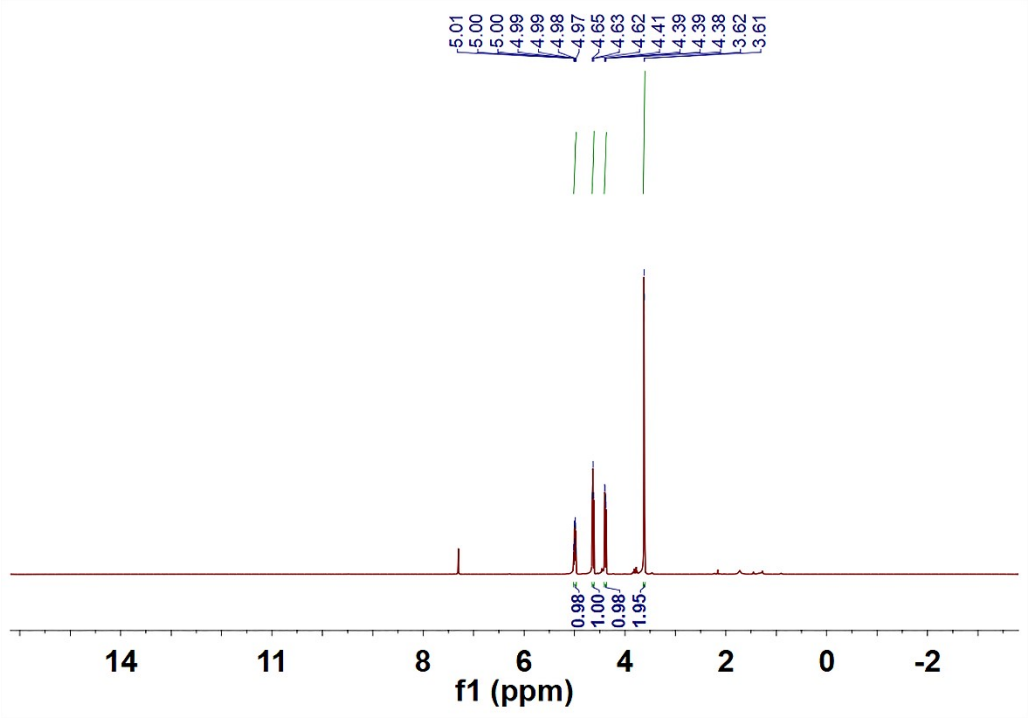

Figure S7 ^{1}H NMR spectrum of 4-(bromomethyl)-1,3-dioxolan-2-one

^{1}H NMR (500 MHz, $CDCl_3$) δ 5.02 – 4.96 (m, 1H), 4.66 – 4.61 (m, 1H), 4.39 (dd, J = 8.9, 5.9 Hz, 1H), 3.62 (d, J = 5.2 Hz, 2H).

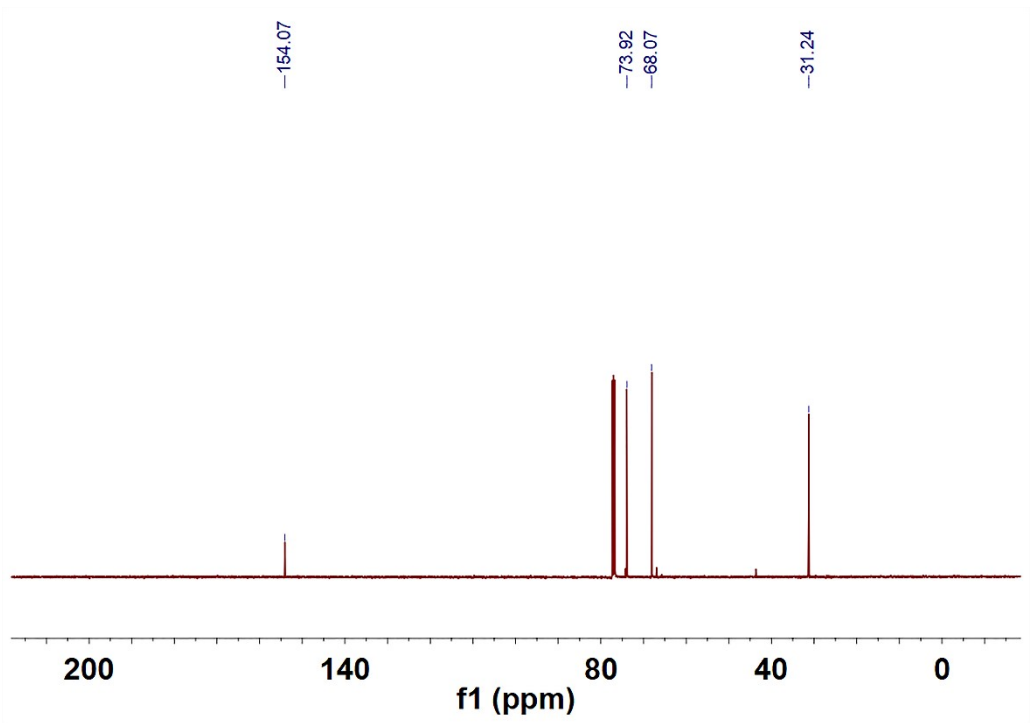

Figure S8 ^{13}C NMR spectrum of 4-(bromomethyl)-1,3-dioxolan-2-one

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.07 (s), 73.92 (s), 68.07 (s), 31.24 (s).

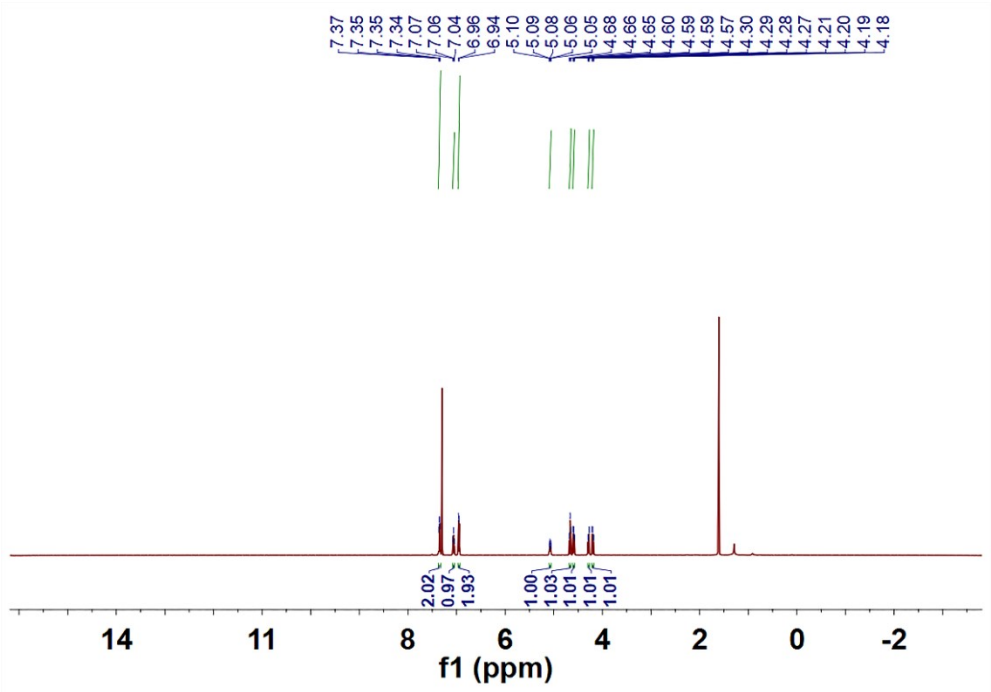

Figure S9 ^{1}H NMR spectrum of 4-(phenoxymethyl)-1,3-dioxolan-2-one

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 (dd, J = 8.6, 7.4 Hz, 2H), 7.06 (t, J = 7.4 Hz, 1H), 6.95 (d, J = 7.9 Hz, 2H), 5.10 – 5.05 (m, 1H), 4.66 (t, J = 8.4 Hz, 1H), 4.59 (dd, J = 8.5, 5.9 Hz, 1H), 4.28 (dd, J = 10.5, 4.3 Hz, 1H), 4.20 (dd, J = 10.5, 3.6 Hz, 1H).

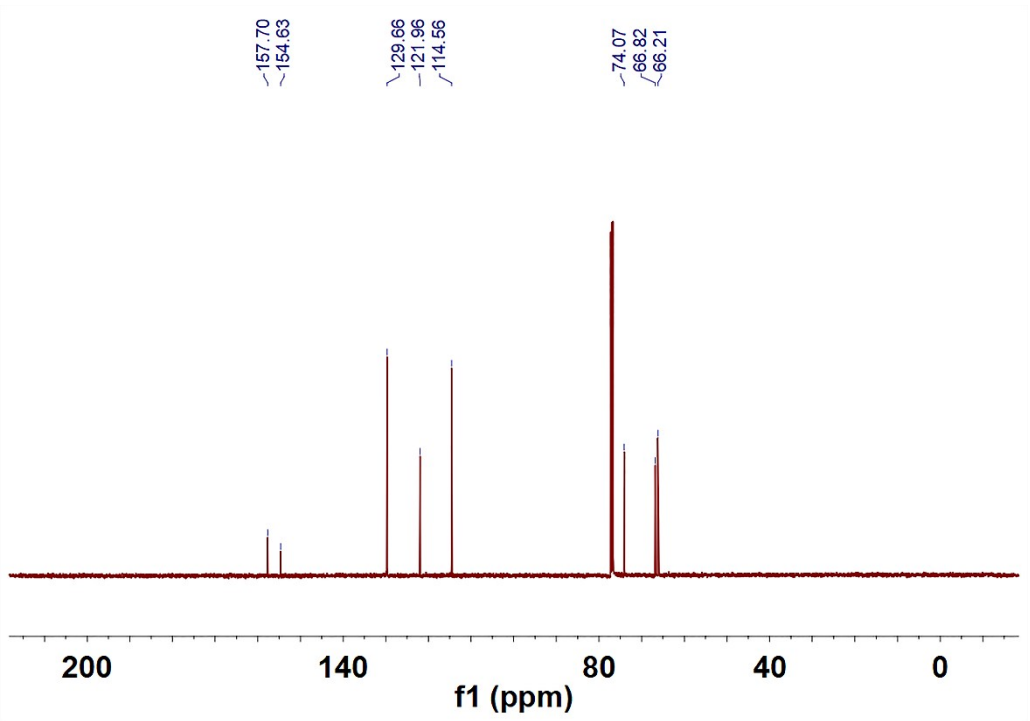

Figure S10 ^{13}C NMR spectrum of 4-(phenoxymethyl)-1,3-dioxolan-2-one

^{13}C NMR (126 MHz, $CDCl_3$) δ 157.70 (s), 154.63 (s), 129.66 (s), 121.96 (s), 114.56 (s), 74.07 (s), 66.82 (s), 66.21 (s).

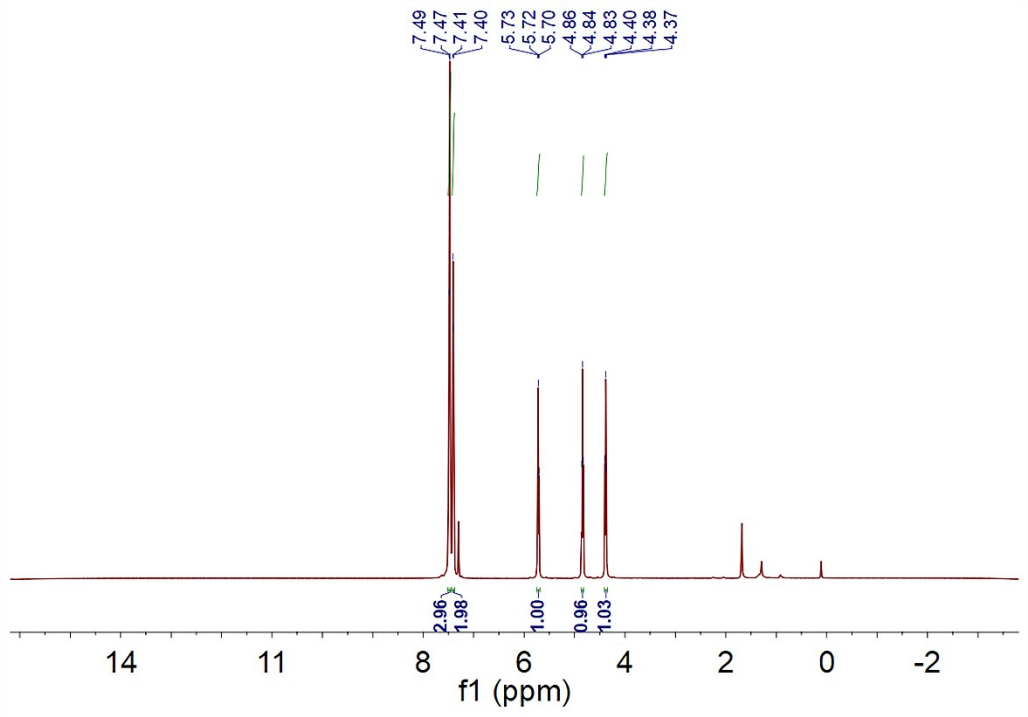

Figure S11 ^{1}H NMR spectrum of 4-phenyl-1, 3-dioxolan-2-one

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.48 (d, J = 6.8 Hz, 3H), 7.40 (d, J = 7.1 Hz, 2H), 5.72 (t, J = 8.0 Hz, 1H), 4.84 (t, J = 8.4 Hz, 1H), 4.38 (t, J = 8.2 Hz, 1H).

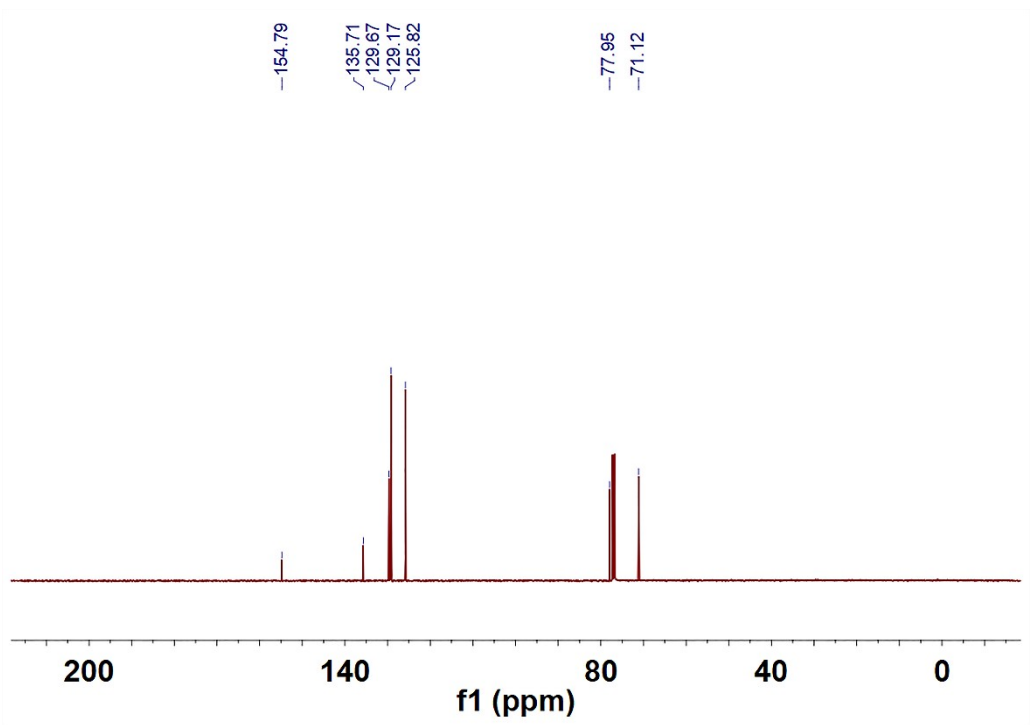

Figure S12 ^{13}C NMR spectrum of 4-phenyl-1, 3-dioxolan-2-one

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.79 (s), 135.71 (s), 129.67 (s), 129.17 (s), 125.82 (s), 77.95 (s), 71.12 (s).

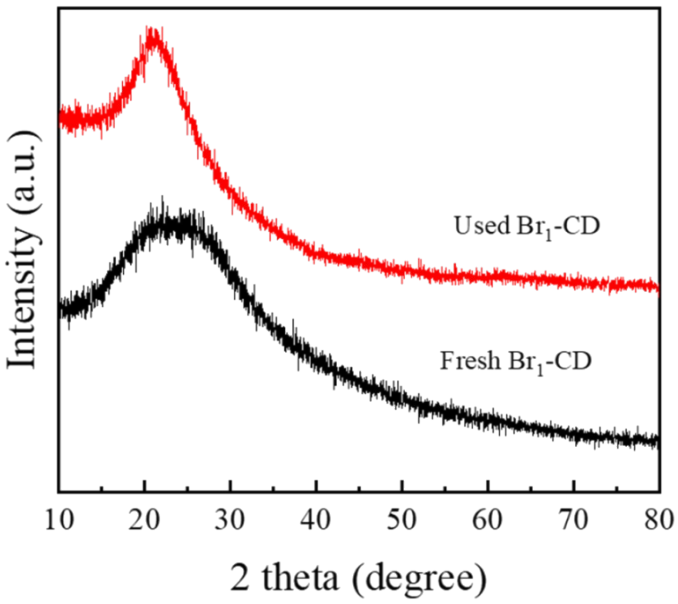

Figure S13 XRD spectra of fresh and used Br_1-CD

Table S1 Textual properties of carbon dots

sample	S_{BET} [a] ($cm^2\ g^{-1}$)	V_{total} [b] ($cm^3\ g^{-1}$)	D_{total} [c] ($cm^3\ g^{-1}$)
NCD	66.937	0.153	9.143
Br_1-CD	15.167	0.074	19.533
$Br_{0.5}$-CD	60.942	0.126	8.271
$Br_{0.1}$-CD	9.557	0.069	28.722
Cl_1-CD	170.588	0.299	7.011
$Cl_{0.5}$-CD	16.081	0.032	7.862
$Cl_{0.1}$-CD	5.151	0.056	43.834

[a] BET surface area

[b] Total pore volume

[c] Average pore size for total pores

Table S2 Br^-content of reused carbon dots

Catalyst	Br^-content (mmol/g) [a]
Reused Br_1-CD	0.890

[a] Br^- content detected by IC