Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.


# Supporting information

## Make waste profitable: repurposing SAPO-34 coke from methanol - to-olefins reaction for luminescent CDs@zeolite composites

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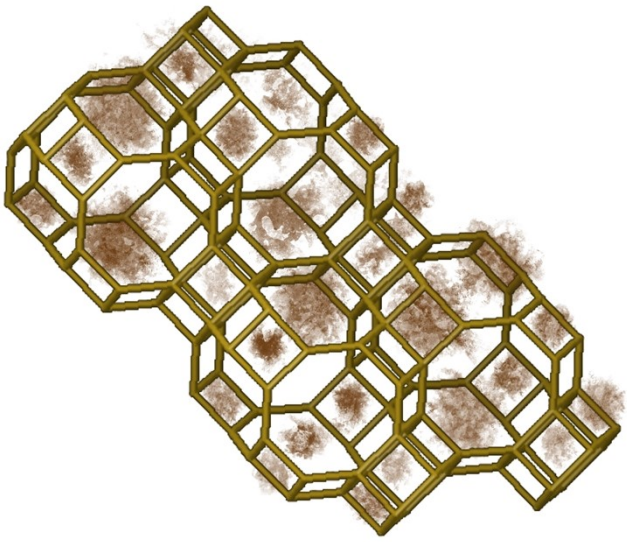

**Fig. S1.** Schematic diagram of SAPO-34 zeolite and the confined coke (brown filler).

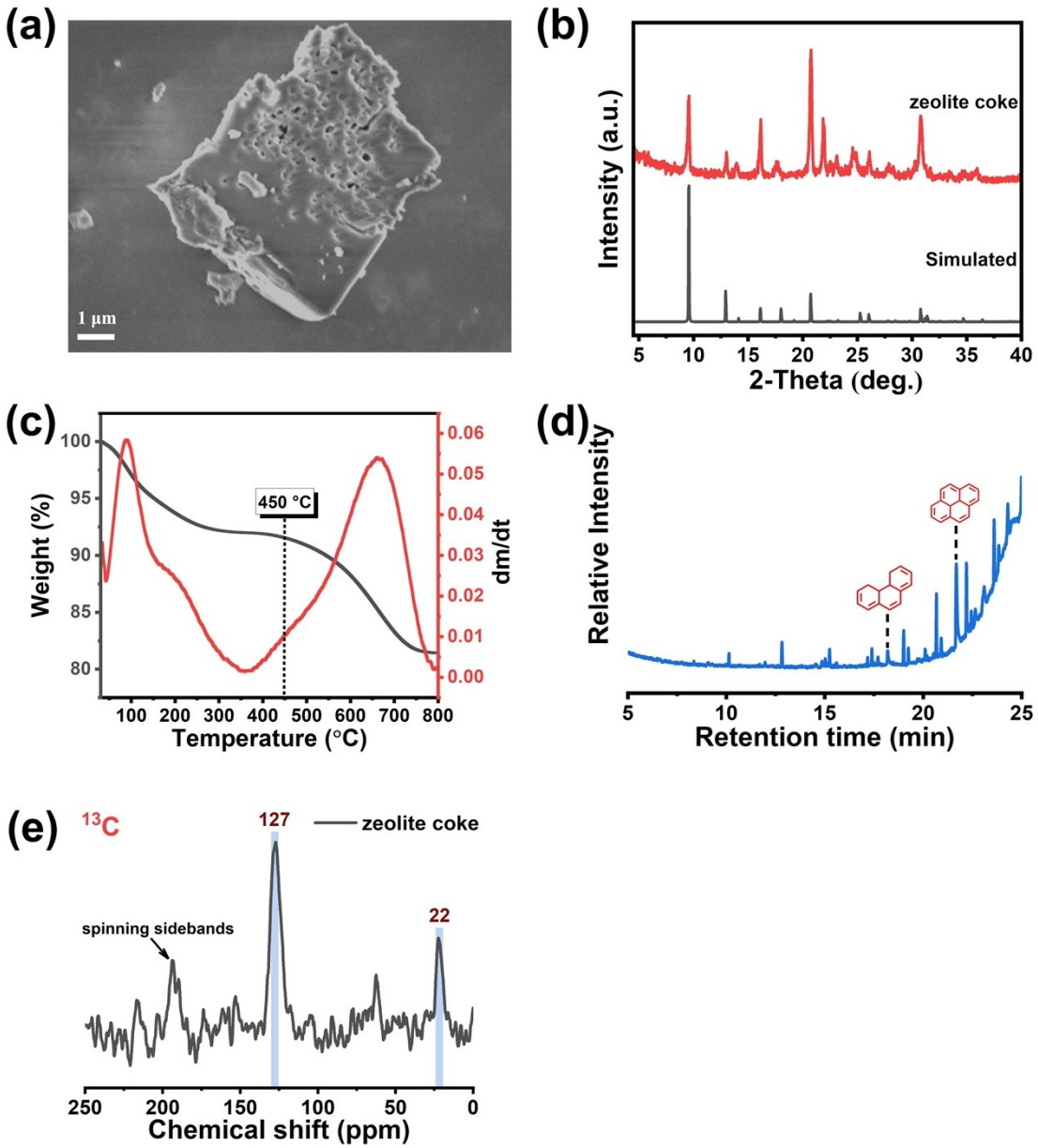


**Fig. S2.** (a) SEM image of deactivated SAPO-34 zeolite. (b) PXRD patterns of simulated CHA zeolite and deactivated SAPO-34 zeolite. (c) Thermalgravimetric (TG) curve and differential thermalgravimetric (DTG) curve of deactivated SAPO-34 zeolite. (d) GC-MS chromatogram of occluded organic species in SAPO-34 coke. (e) $^{13}C$ MAS NMR spectrum of zeolite coke.

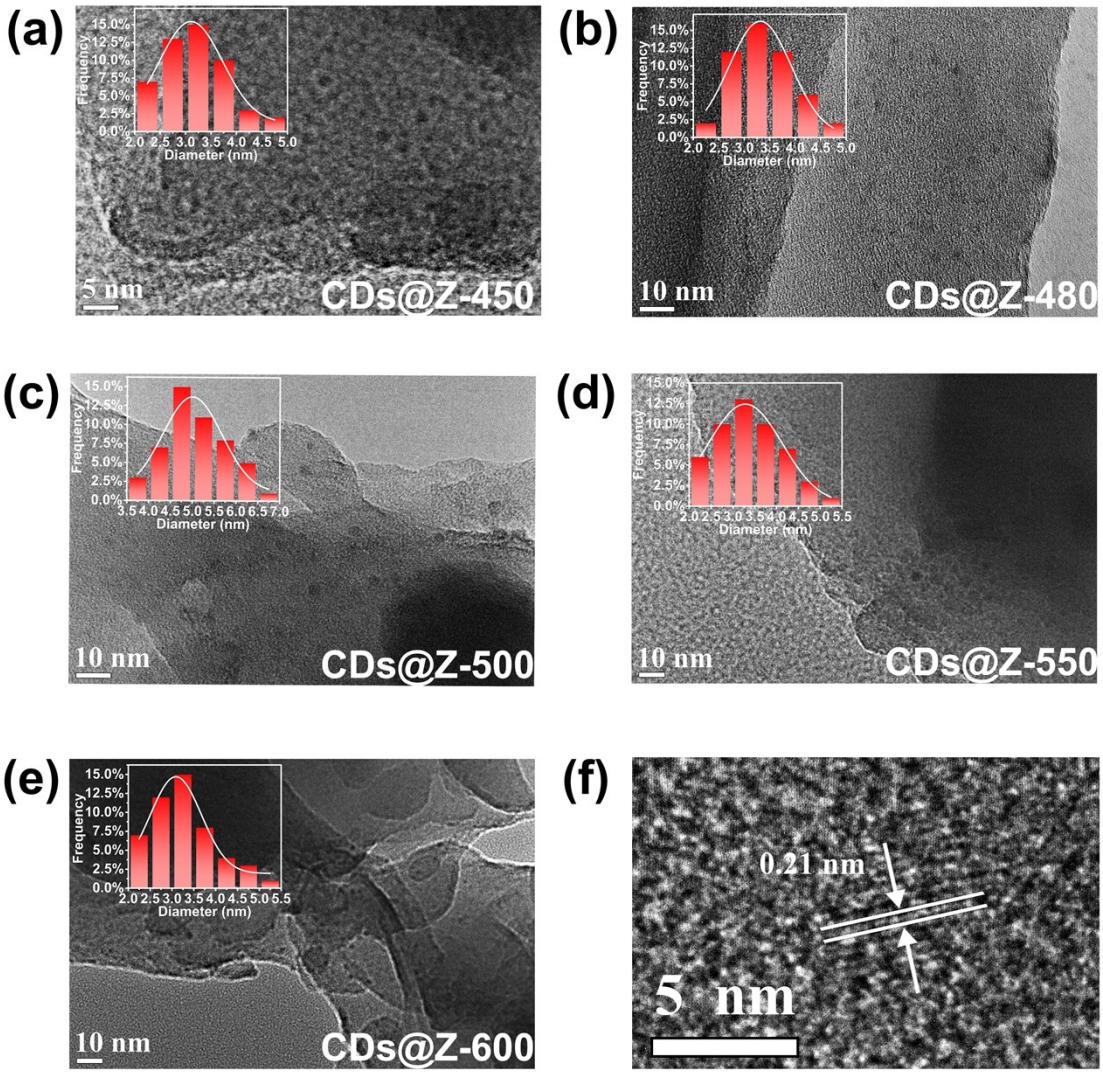


**Fig. S3.** (a-e) TEM images (inset: the particle diameter distribution of CDs) of CDs@Z-T (T=450, 480, 500, 550, 600) composites, respectively. (f) HRTEM image of CDs retained in CDs@Z-520 composite.

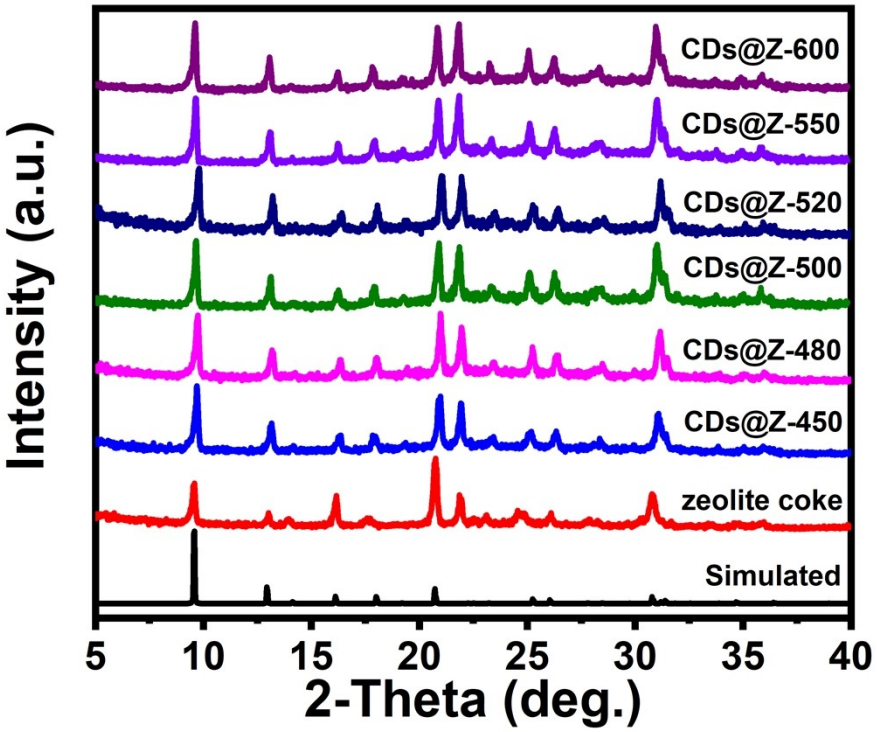


**Fig. S4.** PXRD patterns of CDs@Z-T composites.

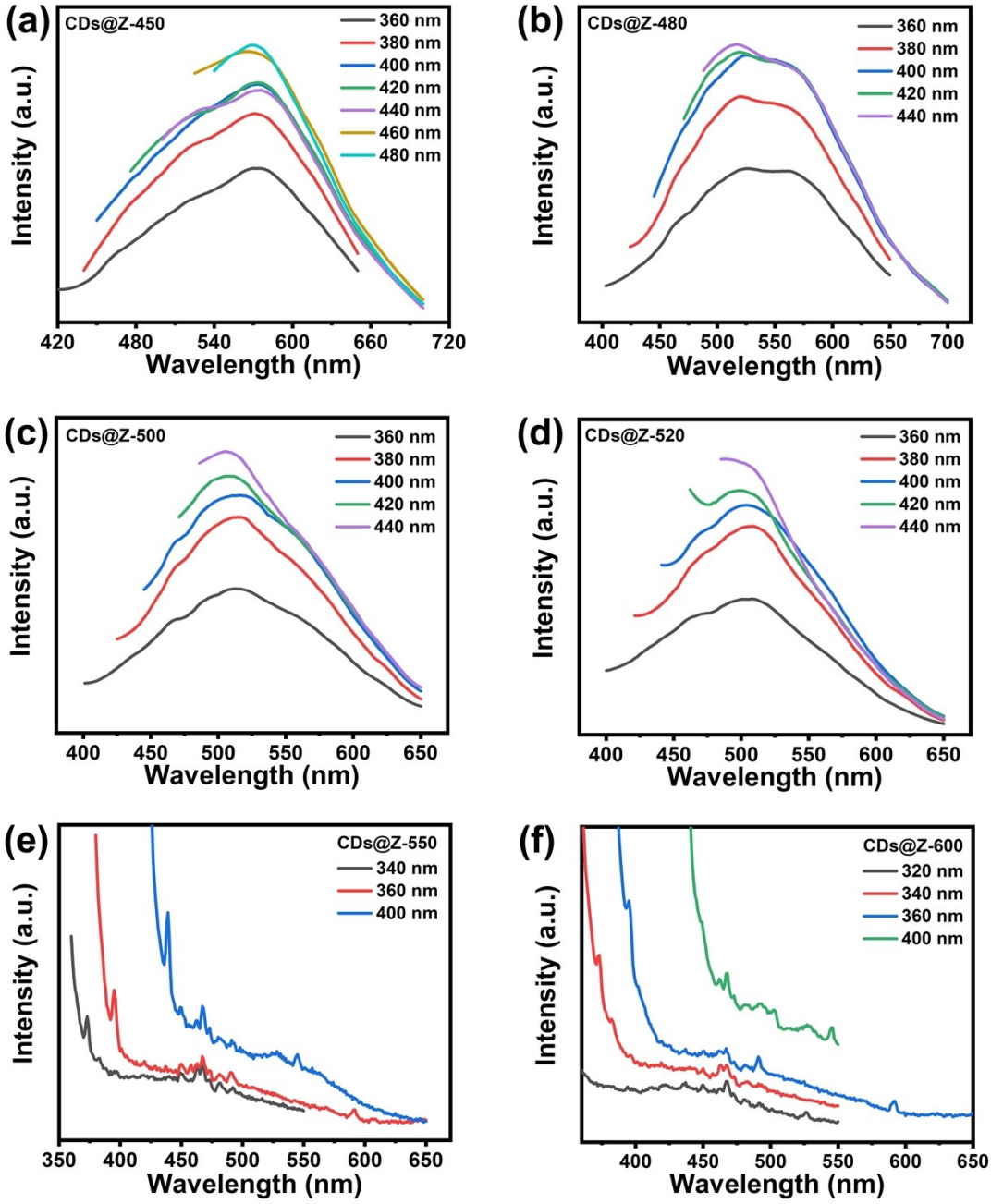


**Fig. S5.** The fluorescence emission spectra of CDs@Z-T composite under different excitation wavelengths.

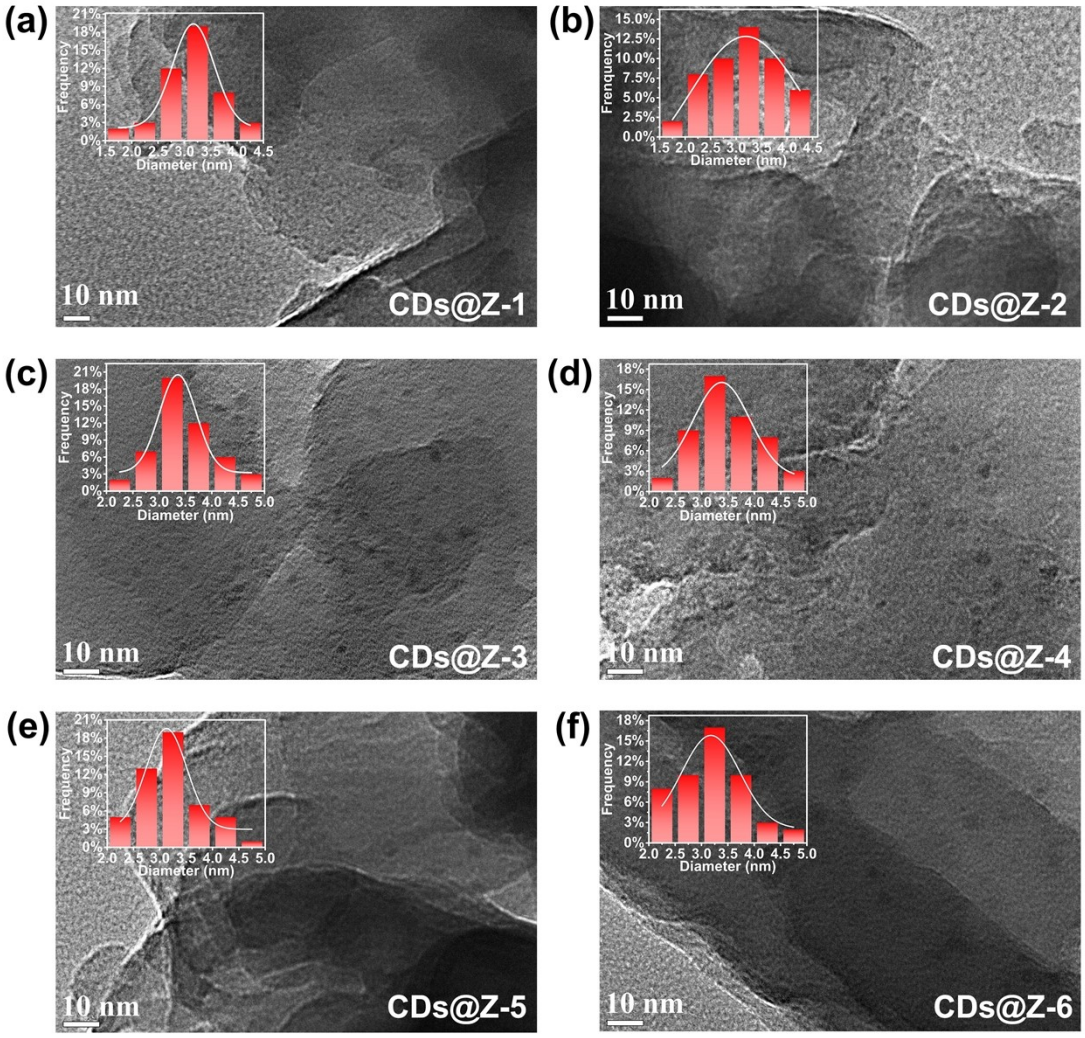


**Fig. S6.** TEM images of the CDs embedded in CDs@Z-t composites (inset: the particle diameter distribution of the CDs particle).

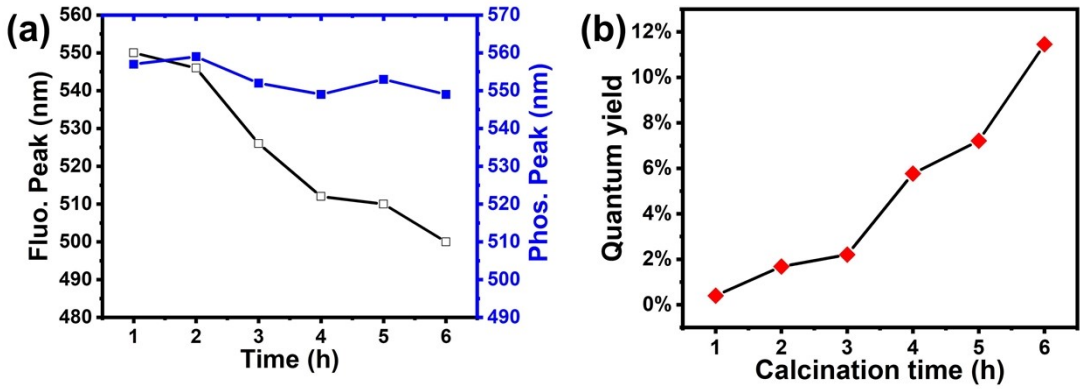


**Fig. S7.** (a) Fluorescence and phosphorescence emission peaks positions of CDs@Z-t, (b) Luminescent quantum yields of CDs@Z-t at different calcination time for 520 ℃.

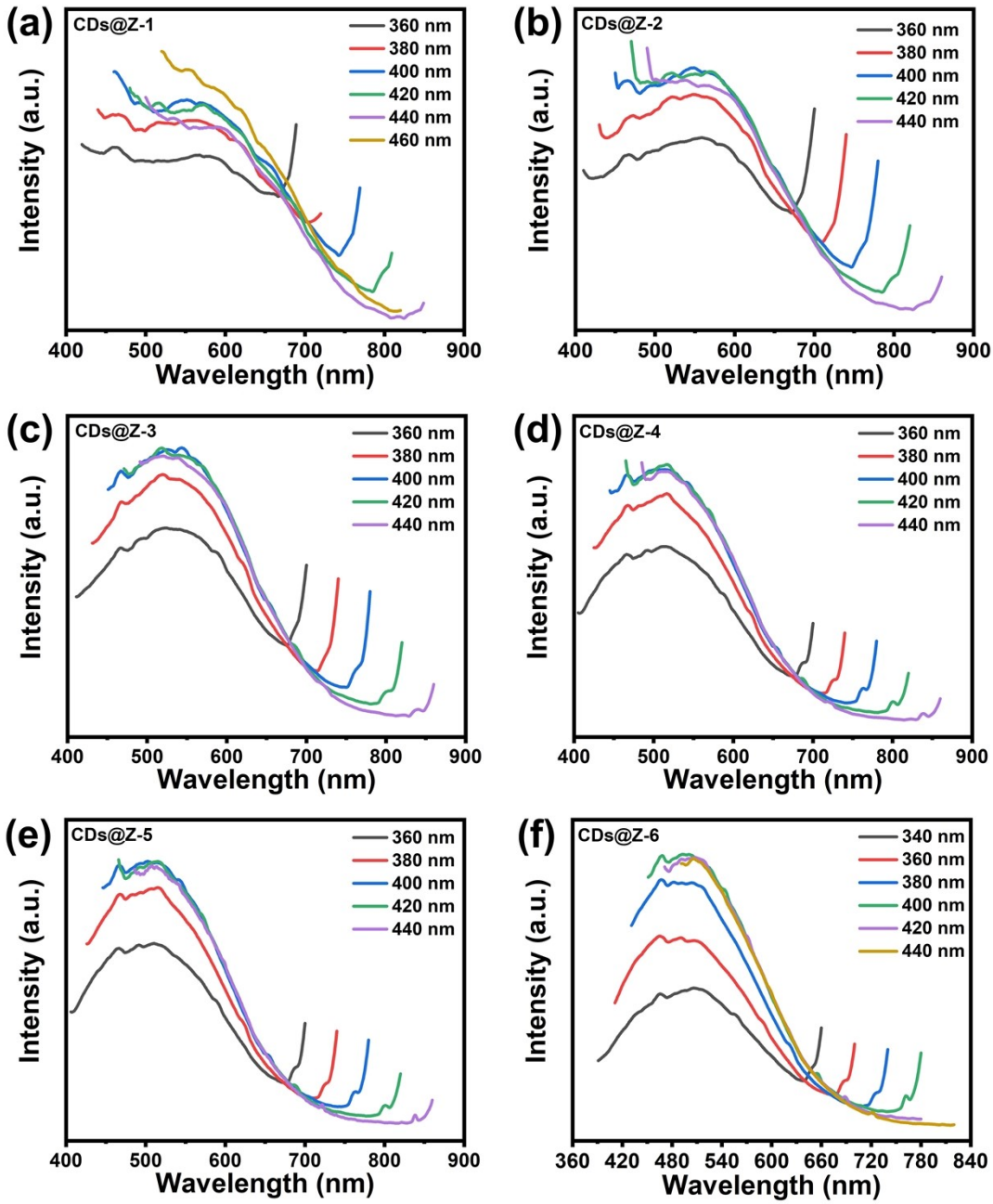


**Fig. S8.** The fluorescence emission spectra of CDs@Z-t composite under different excitation wavelengths (t=1、2、3、4、5、6).

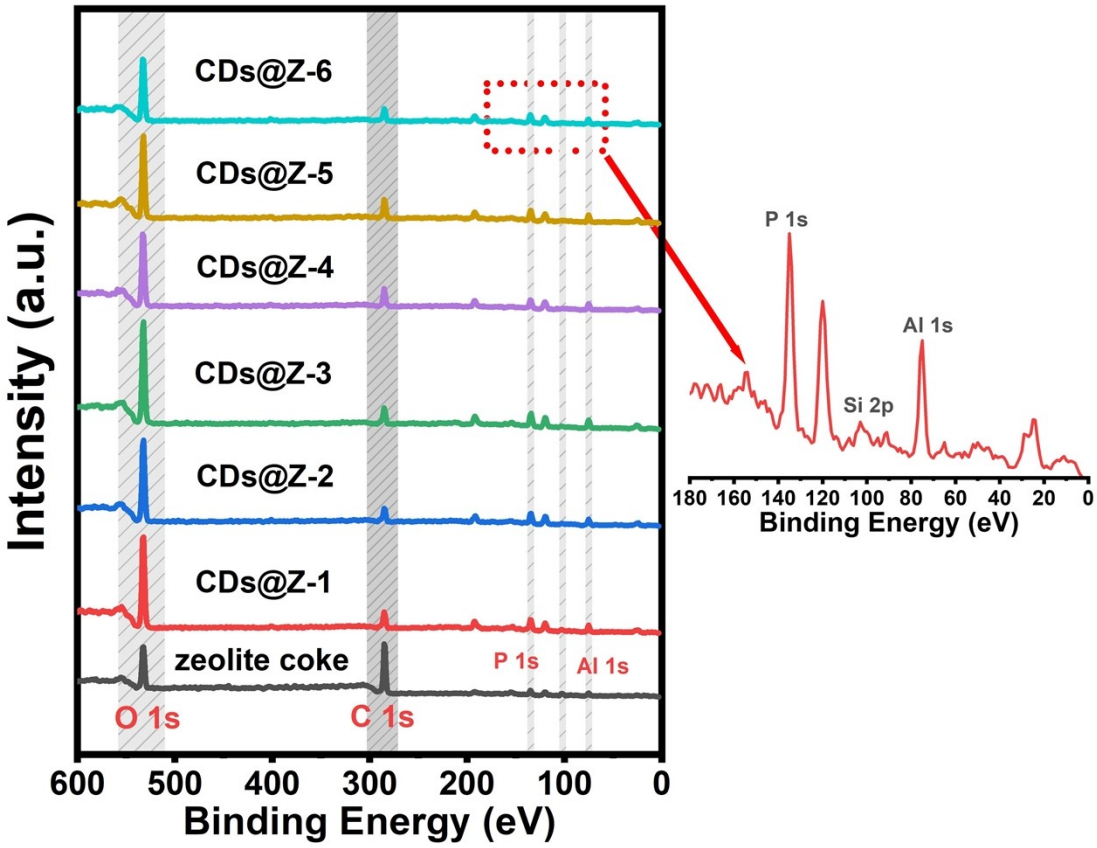


**Fig. S9.** XPS spectra of the zeolite coke and CDs@Z-t (t=1、2、3、4、5、6).

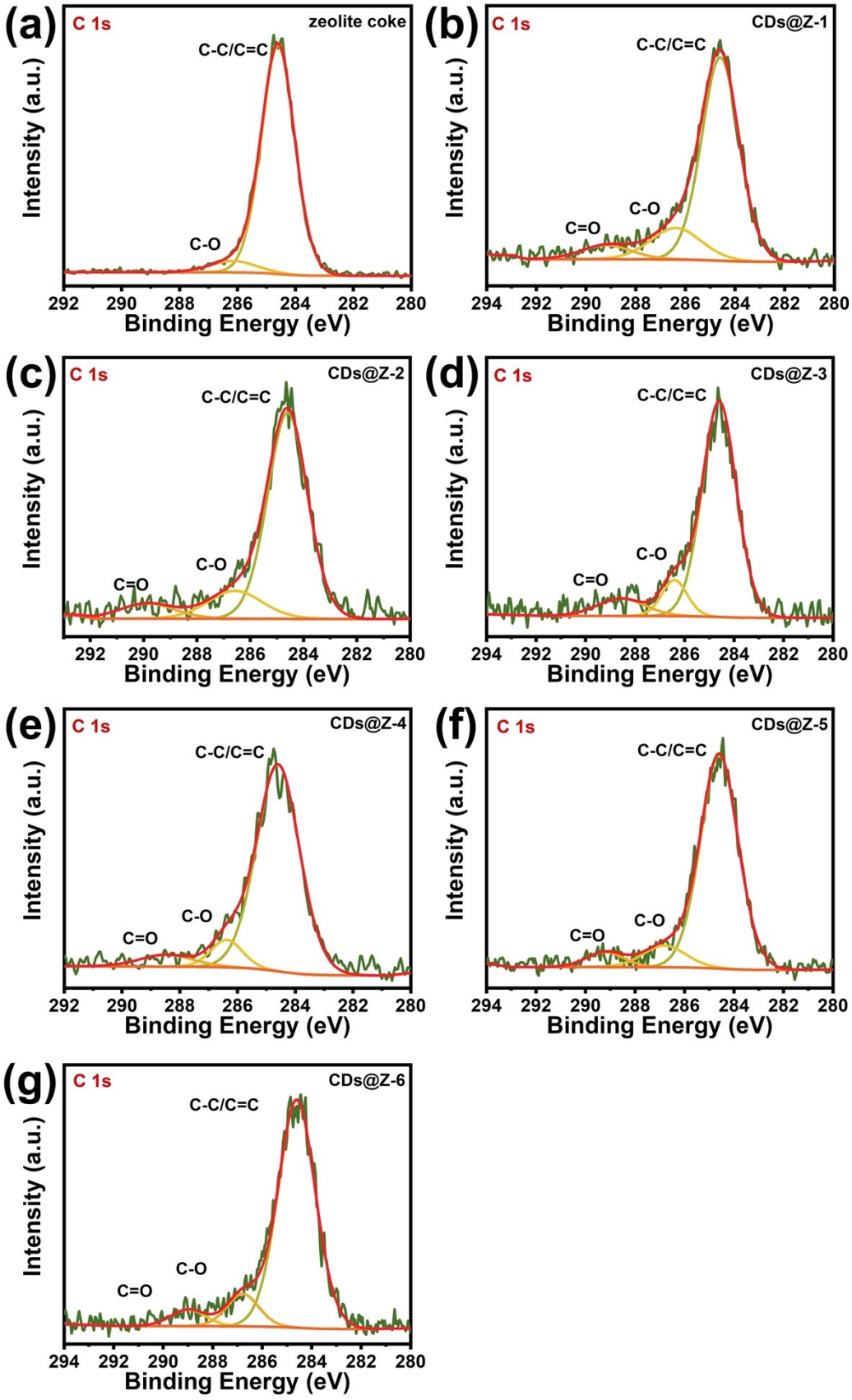


**Fig. S10.** C 1s high resolution fitting curves of zeolite coke and CDs@Z-t (t=1、2、3、4、5、6).

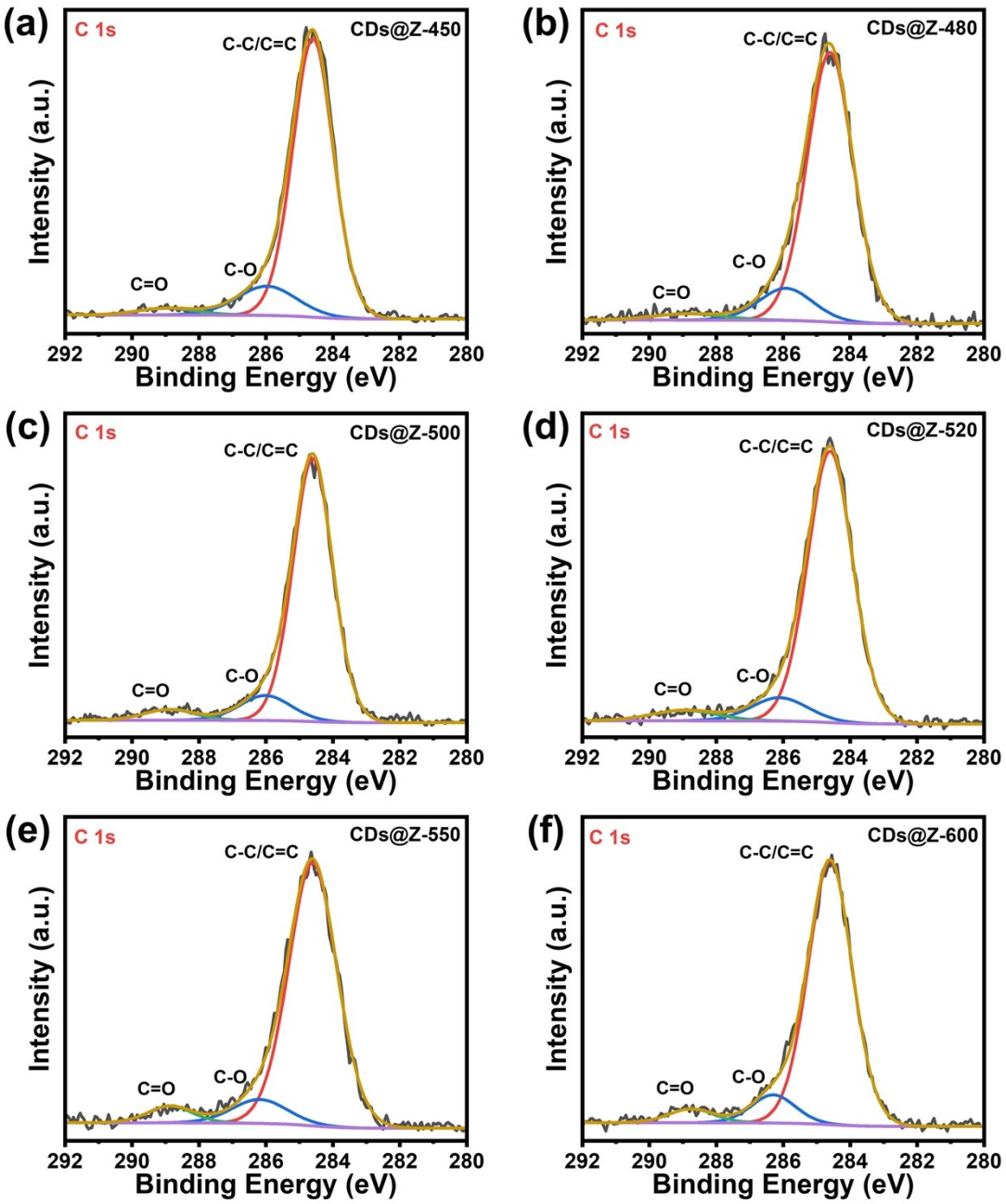


**Fig. S11.** C1s high resolution fitting curve of zeolite coke and CDs@Z-T (T=450、480、500、520、550、600).

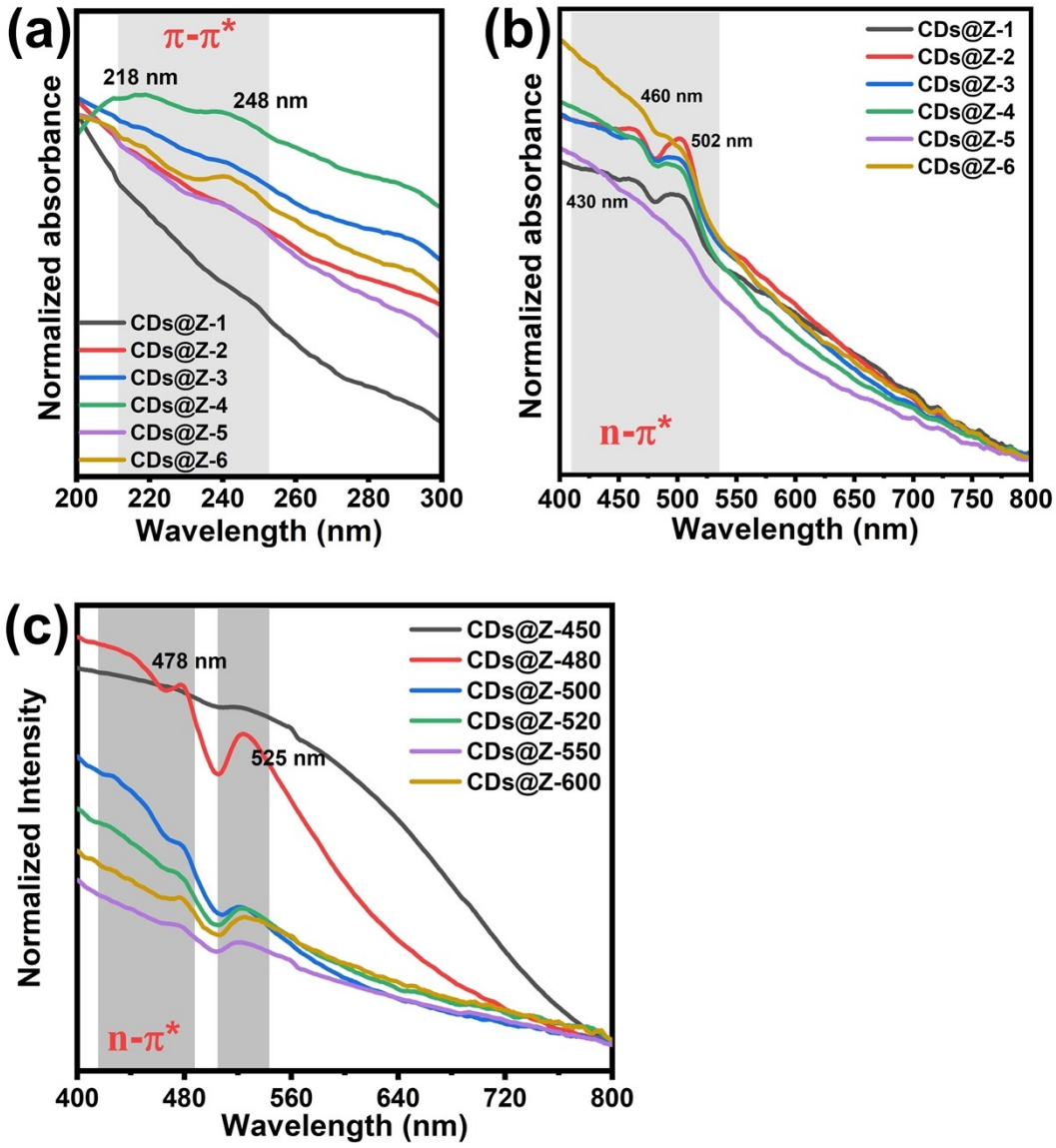


**Fig. S12.** UV-vis spectra of (a) CDs@Z-t composites (200-300 nm), (b) CDs@Z-t composites and (c) CDs@Z-T composites in the range of 400-800 nm.

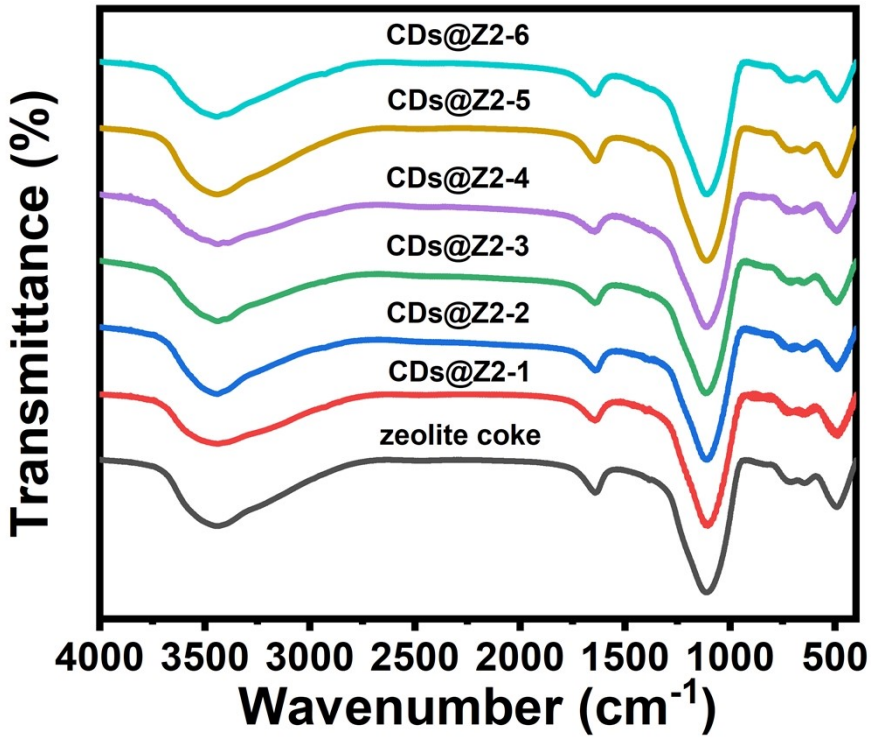


**Fig. S13.** FTIR spectra of CDs@Z-t composites.

**Table S1**. CHN element analysis of CDs@Z-T (T=450，480，500，520，550，600).

| Samples | C (wt%) | N (wt%) | H (wt%) |
|---|---|---|---|
| zeolite coke | 10.55 | 0 | 1.59 |
| CDs@Z-450 | 1.41 | 0 | 1.87 |
| CDs@Z-480 | 0.65 | 0 | 1.89 |
| CDs@Z-500 | 0.42 | 0 | 1.89 |
| CDs@Z-520 | 0.43 | 0 | 1.91 |
| CDs@Z-550 | 0.32 | 0 | 1.87 |
| CDs@Z-600 | 0.28 | 0 | 1.87 |

**Table S2.** Fitting parameters for the FL decay curves of the CDs@Z-T composite.

| Sample | $\tau_1$ (ns) | $B_1$ (%) | $\tau_2$ (ns) | $B_2$ (%) | $\tau_{avg}$ (ns) | $\chi^2$ |
|---|---|---|---|---|---|---|
| CDs@Z-450 | 1.31 | 52.96 | 5.93 | 47.04 | 3.49 | 1.33 |
| CDs@Z-480 | 1.45 | 43.24 | 6.86 | 56.76 | 4.52 | 1.43 |
| CDs@Z-500 | 2.04 | 43.68 | 7.96 | 56.32 | 5.37 | 1.31 |
| CDs@Z-520 | 2.90 | 41.09 | 9.66 | 58.91 | 6.88 | 1.20 |
| CDs@Z-550 | 3.32 | 31.46 | 11.55 | 68.54 | 8.96 | 1.18 |
| CDs@Z-600 | 3.30 | 34.48 | 11.72 | 65.52 | 8.82 | 1.28 |

**Table S3.** Fitting parameters for the RTP decay curves of the CDs@Z-T composites.

| Sample | $\tau_1$ (ms) | $B_1$ (%) | $\tau_2$ (ms) | $B_2$ (%) | $\tau_3$ (ms) | $B_3$ (%) | $\tau_{avg}$ (ms) | $\chi^2$ |
|---|---|---|---|---|---|---|---|---|
| CDs@Z-450 | 17 | 14.69 | 103 | 57.10 | 345 | 28.21 | 158 | 1.35 |
| CDs@Z-480 | 16 | 10.12 | 112 | 56.07 | 372 | 33.82 | 190 | 1.20 |
| CDs@Z-500 | 19 | 9.39 | 126 | 54.27 | 411 | 36.34 | 220 | 1.28 |
| CDs@Z-520 | 23 | 10.88 | 134 | 57.81 | 453 | 37.31 | 249 | 1.30 |
| CDs@Z-550 | 37 | 20.29 | 176 | 79.71 | | | 147 | 1.34 |
| CDs@Z-600 | 52 | 26.32 | 180 | 73.68 | | | 147 | 1.26 |

**Table S4.** CHN element analysis of CDs@Z-t composites (t=1、2、3、4、5、6).

| Sample | C (wt%) | N (wt%) | H (wt%) |
|---|---|---|---|
| zeolite coke | 9.45 | 0.00 | 1.95 |
| CDs@Z-1 | 1.37 | 0.00 | 2.23 |
| CDs@Z-2 | 0.88 | 0.00 | 2.31 |
| CDs@Z-3 | 0.47 | 0.00 | 2.28 |
| CDs@Z-4 | 0.35 | 0.00 | 2.32 |
| CDs@Z-5 | 0.32 | 0.00 | 2.30 |
| CDs@Z-6 | 0.30 | 0.00 | 2.29 |

**Table S5.** Fitting parameters for the FL decay curves of the CDs@Z-t composites.

| Sample | $\tau_1$ (ns) | $B_1$ (%) | $\tau_2$ (ns) | $B_2$ (%) | $\tau_3$ (ns) | $B_3$ (%) | $\tau_{avg}$ (ns) | $\chi^2$ |
|---|---|---|---|---|---|---|---|---|
| CDs@Z-1 | 0.56 | 29.41 | 2.57 | 47.29 | 9.32 | 23.30 | 3.55 | 1.12 |
| CDs@Z-2 | 0.69 | 24.35 | 2.97 | 51.27 | 10.48 | 24.38 | 4.25 | 1.05 |
| CDs@Z-3 | 0.90 | 21.78 | 3.55 | 49.14 | 10.82 | 29.07 | 5.09 | 0.99 |
| CDs@Z-4 | 0.94 | 16.38 | 3.77 | 49.86 | 10.96 | 33.76 | 5.73 | 0.95 |
| CDs@Z-5 | 1.03 | 15.08 | 3.75 | 47.06 | 10.85 | 37.86 | 6.03 | 1.06 |
| CDs@Z-6 | 1.12 | 12.44 | 4.02 | 48.98 | 11.23 | 38.58 | 6.44 | 1.00 |

**Table S6.** Fitting parameters for the RTP decay curves of the CDs@Z-t composites.

| Sample | $\tau_1$ (ms) | $B_1$ (%) | $\tau_2$ (ms) | $B_2$ (%) | $\tau_3$ (ms) | $B_3$ (%) | $\tau_{avg}$ (ms) | $\chi^2$ |
|---|---|---|---|---|---|---|---|---|
| CDs@Z-1 | 0.42 | 9.83 | 5.61 | 21.82 | 96.27 | 68.35 | 67.07 | 1.12 |
| CDs@Z-2 | 1.37 | 10.95 | 13.22 | 28.02 | 135.7 | 61.04 | 86.69 | 1.20 |
| CDs@Z-3 | 3.27 | 11.76 | 33.91 | 28.94 | 190.9 | 59.30 | 123.40 | 1.27 |
| CDs@Z-4 | 2.25 | 8.69 | 18.48 | 23.46 | 151.1 | 67.85 | 106.98 | 1.31 |
| CDs@Z-5 | 3.86 | 11.18 | 41.49 | 29.95 | 235.7 | 58.87 | 151.61 | 1.18 |
| CDs@Z-6 | 4.66 | 11.92 | 46.58 | 26.65 | 252.5 | 61.43 | 168.08 | 1.24 |

**Table S7.** C1s deconvolution of XPS spectra of CDs@Z-t (T=1、2、3、4、5、6).

| Sample | C-C/C=C (%) | C-O (%) | C=O (%) | C-O and C=O (%) |
|---|---|---|---|---|
| CDs@Z-1 | 76.68 | 16.16 | 7.16 | 23.32 |
| CDs@Z-2 | 77.84 | 14.32 | 7.84 | 22.16 |
| CDs@Z-3 | 80.71 | 10.10 | 9.19 | 19.29 |
| CDs@Z-4 | 83.61 | 10.20 | 6.19 | 16.39 |
| CDs@Z-5 | 84.39 | 9.75 | 5.86 | 15.61 |
| CDs@Z-6 | 84.02 | 10.27 | 5.71 | 15.98 |

**Table S8.** C 1s deconvolution of XPS spectra of CDs@Z-T (T=450、480、500、520、550、600).

| Sample | C-C/C=C (%) | C-O (%) | C=O (%) | C-O and C=O (%) |
|---|---|---|---|---|
| CDs@Z-450 | 84.13 | 12.90 | 2.98 | 15.87 |
| CDs@Z-480 | 85.05 | 11.88 | 3.06 | 14.95 |
| CDs@Z-500 | 85.15 | 10.41 | 4.43 | 14.85 |
| CDs@Z-520 | 85.83 | 9.30 | 4.87 | 14.17 |
| CDs@Z-550 | 85.93 | 8.96 | 5.11 | 14.07 |
| CDs@Z-600 | 86.17 | 9.20 | 4.63 | 13.83 |