Supporting Information

Thermally Activated Delayed Fluorescence from Confined Carbon Dots Activated by Triple Synergy Effect for Advanced Information Encryption

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Figure S1. UV-vis absorption spectra of m-PD.



Figure S2. Fluorescence images of CDs before and after physical mixing with MMT of different qualities.



Figure S3. XPS survey spectrum of CDs-MMT.



Figure S4. High-resolution XPS spectra of C 1s of CDs-MMT.



Figure S5. High-resolution XPS spectra of N 1s of CDs-MMT.



Figure S6. UV-vis absorption spectra of CDs-MMT.



Figure S7. Delayed fluorescence photos of CDs-MMT@PVA film after the UV lamp was turned

off.



Figure S8. Fluorescence excitation spectra of CDs-MMT@PVA films.



Figure S9. Delayed fluorescence excitation spectra of CDs-MMT@PVA films.



Figure S10. The mechanism of the afterglow emission diagram.



Figure S11. The temperature-dependent time-resolved decay spectra of CDs-MMT@PVA at 520 nm emission.



Figure S12. ¹H NMR spectrum of CDs-MMT in DMSO-*d6*.



Figure S13. ¹H NMR spectrum of CDs-MMT@PVA in DMSO-d6.

Sample	CDs (m-PD)	CDs (acidified m-PD)	CDs (m-PD-MMT)
1	12.9 mV	43.9 mV	1.93 mV
2	16.5 mV	44.4 mV	7.8 mV
3	9.21 mV	45.8 mV	8.2 mV
average	12.87 mV	44.7 mV	5.98 mV

Table S1. The charging properties of CDs formed after different precursor reactions

Table S2. Fluorescence quantum yield of m-CDs and CDs-MMT

Sample	QY (%)
m-CDs	4.59
CDs-MMT	72.17

Sample	OY (%)
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	15 ()
	43.00

Table S3. Fluorescence quantum yield of the CDs-MMT@PVA film

Table S4. TADF lifetime of CDs-MMT@PVA at different temperatures

T (K)	$\tau_1$ (ms)	A ₁ (%)	$ au_2$ (ms)	A ₂ (%)	$\chi^2$	$ au_{\rm ave}({ m ms})$
80	0.86	69.36	9.76	30.64	1.008	1.57
100	0.53	50.8	6.78	49.2	1.344	3.6
140	1.66	74.41	18.68	25.59	1.430	6.01
180	1.58	44.28	55.31	55.72	1.257	31.52
220	1.58	7.34	52.39	92.66	1.49	48.66
260	3.37	7.04	76.37	92.96	1.358	71.16
300	10.08	13.97	71.43	86.03	1.392	62.85

Sample	$ au_1(\mathbf{ns})$	A ₁ (%)	$ au_2(\mathbf{ns})$	A ₂ (%)	$\chi^2$	$ au_{\rm ave}({\rm ns})$
CDs-MMT@PVA	1.93	13.59	4.21	86.41	1.19	3.9

Table S5. The fluorescence decay of CDs-MMT@PVA

 Table S6. The TADF decay of CDs-MMT@PVA

Sample	$ au_1$ (ms)	A ₁ (%)	$ au_2$ (ms)	A ₂ (%)	$\chi^2$	$ au_{\mathrm{ave}}(\mathrm{ms})$
CDs-MMT@PVA	10.01	81.81	121.2	18.19	1.27	30.23

Sample	CDs (m-PD-MMT)	PVA
1	1.93 mV	10.1 mV
2	7.8 mV	11.1 mV
3	8.2 mV	11.3 mV
average	5.98 mV	10.8 mV

Table S7. Zeta potential of CDs-MMT and PVA