**Electronic Supplementary Information(ESI)**

# Covalent pendulous anthraquinone polymers coupled on graphenes for efficient capacitor storage in both alkaline and acidic media

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**Figure S1**. Synthesis of TPDA@$NH_2$-rGO,TPDAB@$NH_2$-rGO and TADA@$NH_2$- rGO

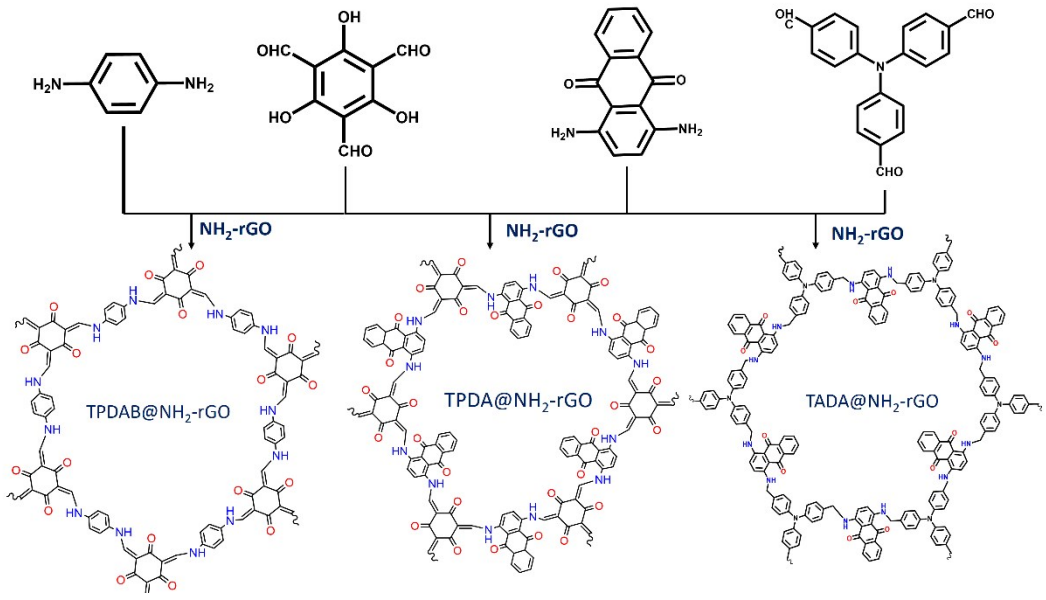


**Figure S2.** (A) The extended structure of TPDA; (B) Pore size distribution curves of TPDA @$NH_2$-rGO

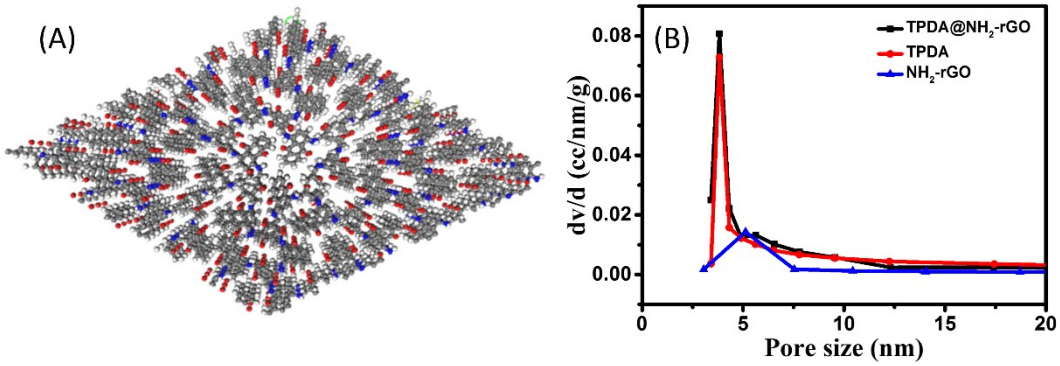

**Figure S3**. (A) XRD patterns of TPDAB @$NH_2$-rGO; (B) XRD patterns of TADA@$NH_2$-rGO; (C) The FT-IR spectra of TPDAB @$NH_2$-rGO; (D) The FT-IR spectra of TADA@$NH_2$-rGO.

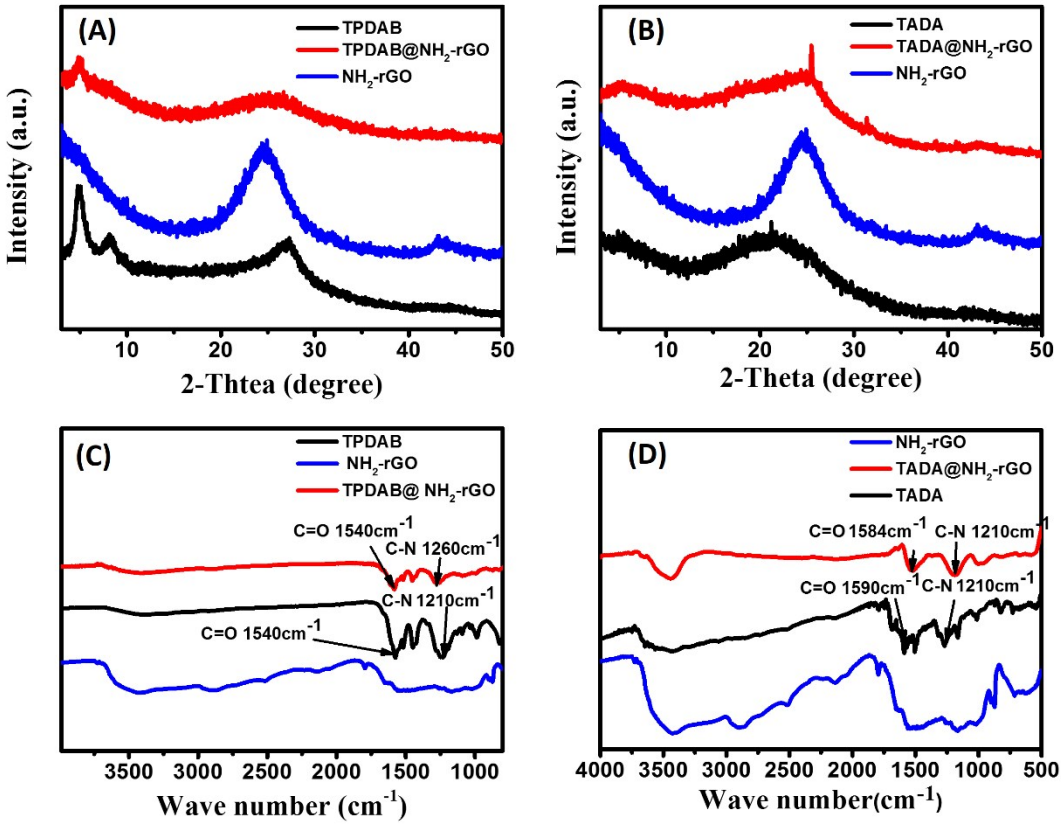

**Figure S4.** (A), (B), (C), (D) TEM images of TPDA; (E) ,(F) SEM of TPDA@$NH_2$-rGO.

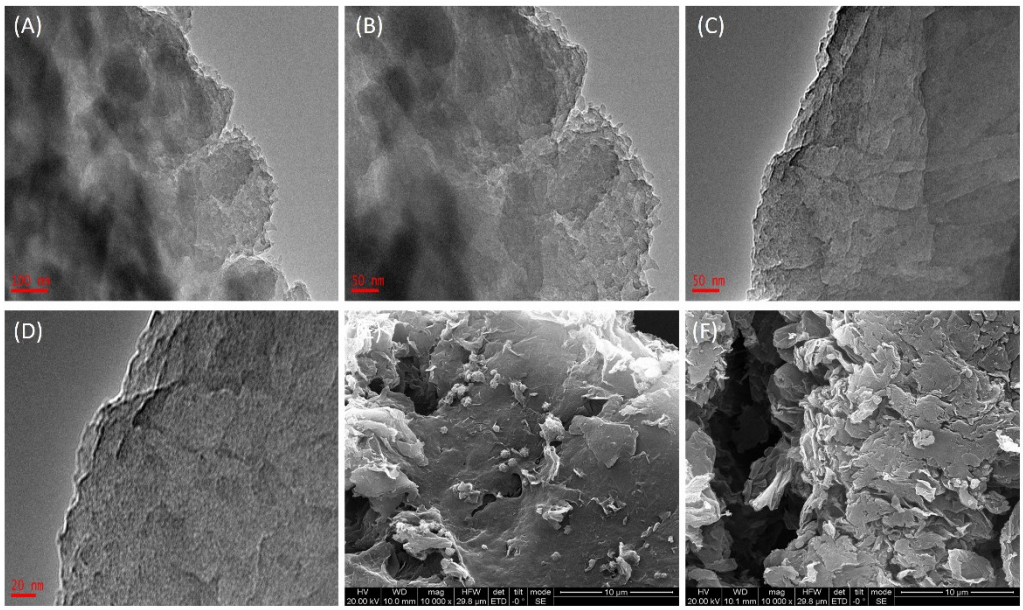


**Figure S5.** Electrochemical performances measured in 6.0 M KOH. (A) Specific capacitances of TPDA@ $NH_2$-rGO at different current densities; (B) Plot for the cyclic performance test of TPDA@$NH_2$-rGO; (C) CV curves of TPDA @ $NH_2$-rGO and $NH_2$-rGO at 50 $mV \cdot s^{-1}$; (D) GCD curves of TPDA @ $NH_2$-rGO and $NH_2$-rGO at 0.2 $A \cdot g^{-1}$.

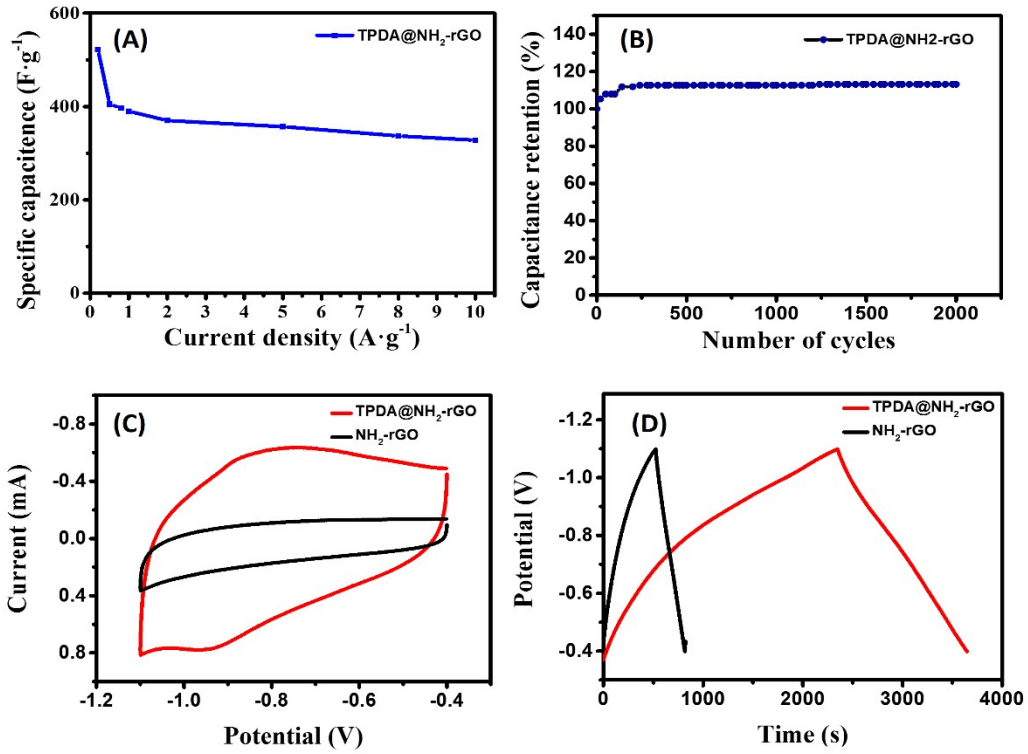

**Figure S6.** Electrochemical performances measured in 6.0 M KOH. (A) CV curves of different COPs at 50 $mV \cdot s^{-1}$; (B) GCD curves of different COPs at 0.2 $A \cdot g^{-1}$; (C) CV curves of TPDA @ $NH_2$-rGO with different $NH_2$-rGO at 50 $mV \cdot s^{-1}$; (D) GCD curves of TPDA@ $NH_2$-rGO with different $NH_2$-rGO at 0.2 $A \cdot g^{-1}$.

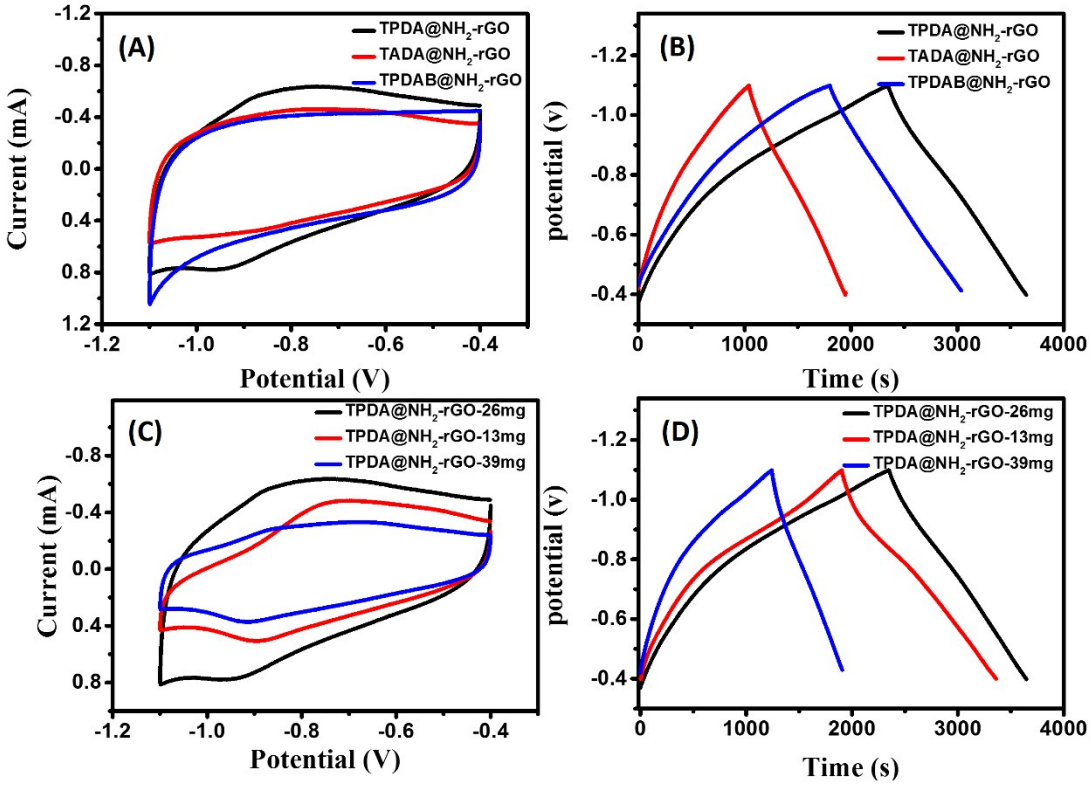


**Figure S7.** (A) Initial state of electrode surface; (B) The electrode surface after GCD test for 3 hours; (C) The electrode surface after GCD test for 6 hours

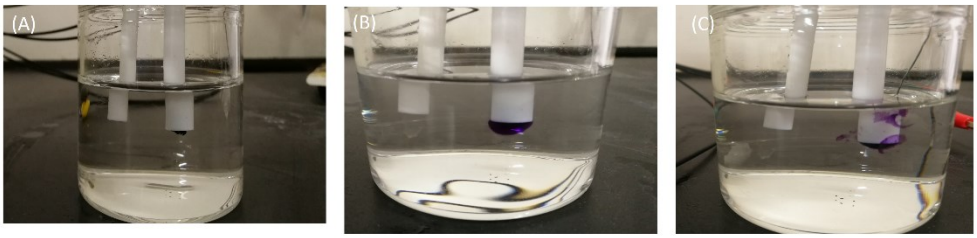

**Figure S8**. (A) $N_2$-sorption isotherm of TADA@NH2-rGO; (B) Pore size distribution curves of TADA @$NH_2$- rGO;

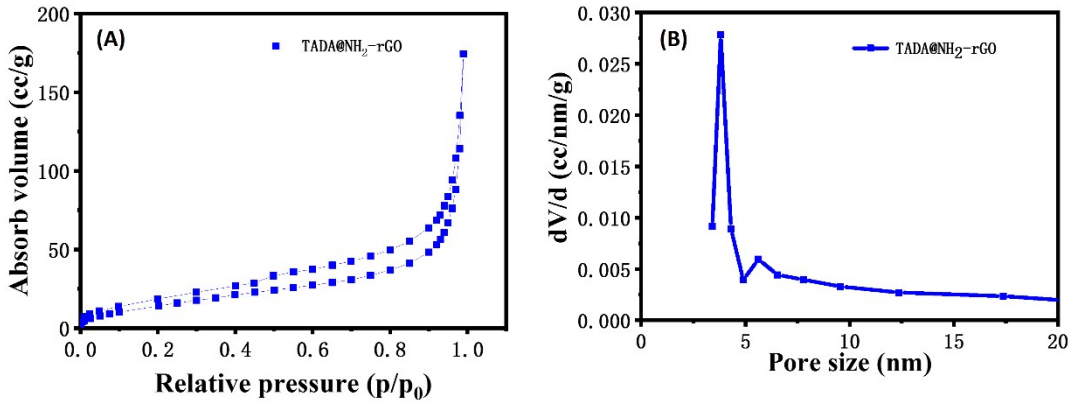


**Figure S9.** Nyquist plot of TADA@$NH_2$-rGO and TPDA@$NH_2$-rGO

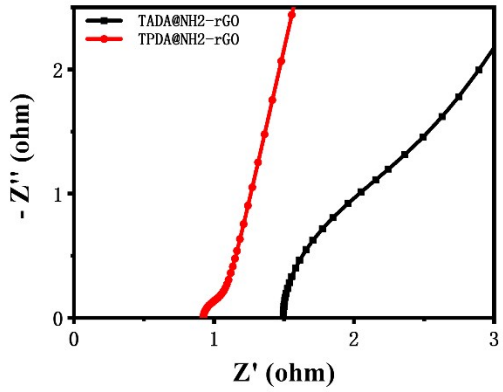


**Figure S10.** (A) Plot for the cyclic performance test of $NH_2$-rGO for 2000 cycles; (B) Plot for the cyclic performance test of TPDA for 2000 cycles.

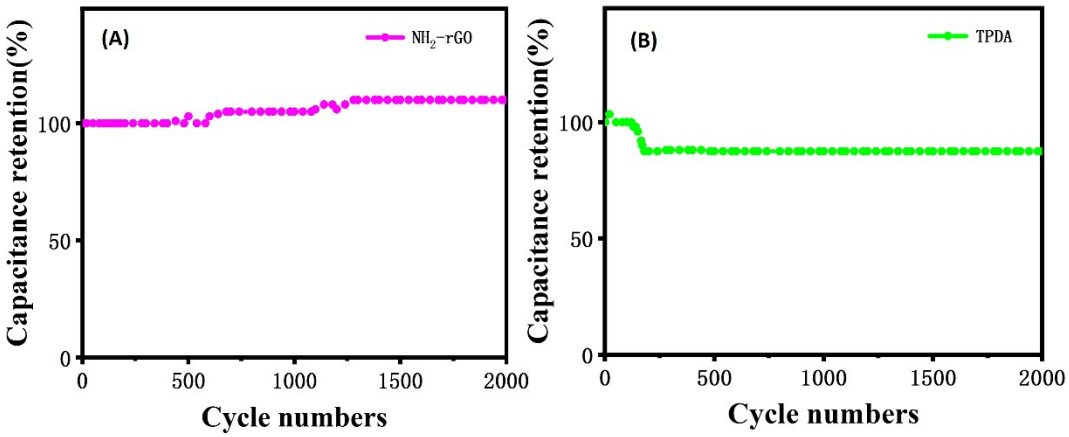

**Table S1.** Comparison of specific capacitance of TPDA@$NH_2$-rGO with other porous materials and carbon materials

| **Electrode materials** | **Electrolyte** | **Specific Capacitance ($F \cdot g^{-1}$)** | **Reference** |
|---|---|---|---|
| TPDA@$NH_2$-rGO | 2 M $H_2SO_4$ | 522 | This work |
| TPDA@$NH_2$-rGO | 6 M KOH | 390 | This work |
| N-rich composite of CNTs | 1 M $H_2SO_4$ | 167 | S1 |
| ammoxidized coals | 7 M KOH | 145 | S2 |
| N-enriched nanostructured carbons | 1 M $H_2SO_4$ | 201 | S3 |
| CNTs/N-enriched carbon | 1 M $H_2SO_4$ | 100 | S4 |
| N-enriched carbon from melaminemica | 6 M KOH | 198 | S5 |
| nitrogen-doped porous nanofibers | 6 M KOH | 202 | S6 |
| TpDAB based (Pristine CPF) | $Na_2SO_4$ (not mentioned) | 432 | S7 |
| TPDA-1 (Pristine POP) | 1 M $H_2SO_4$ | 348 | S8 |
| TAT-CMP-2 (Pristine POP) | 1M $Na_2SO_4$ | 183 | S9 |
| CMP-based hollow | $H_2SO_4$ (not mentioned) | 286 | S10 |
| NPC-800 | 5 M KOH | 230 | S11 |
| 3D HLPC | 6 M KOH | 342 | S12 |
| Nitrogen-rich GMP | 6 M KOH | 273 | S13 |
| TaPa-Py COF | 1 M $H_2SO_4$ | 209 | S14 |
| oxygen functionalized graphene | 2 M $H_2SO_4$ | 296 | S15 |
| Reduced graphene | 2 M $H_2SO_4$ | 163 | S16 |

**Table S2.** The values of equivalent circuit parameters calculated from EIS resuit for TPDA@$NH_2$-rGO.

| | **TPDA @$NH_2$-rGO** | **TPDA** | **$NH_2$-rGO** |
|---|---|---|---|
| Rs ($\Omega$) | 0.9248 | 2.042 | 0.8541 |
| Cdl (mF) | 1.074 | 0.168 | 0.5324 |
| Rct ($\Omega$) | 0.2641 | 1.706 | 0.1481 |
| Q ($F \cdot s^{(a-1)}$) | 0.008317 | 0.03291 | 0.01165 |
| a | 0.8 | 0.8317 | 0.6973 |

**Table S3.** Comparison of specific capacitance of TPDA@$NH_2$-rGO with different content of $NH_2$-rGO.

| **Electrolyte** | **TPDA@$NH_2$-rGO-13mg ($F \cdot g^{-1}$)** | **TPDA@$NH_2$-rGO-26mg ($F \cdot g^{-1}$)** | **TPDA@$NH_2$-rGO-39mg ($F \cdot g^{-1}$)** |
|---|---|---|---|
| 2 M $H_2SO_4$ | 268 | 390 | 175 |
| 6 M KOH | 376 | 522 | 285 |

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