

## Supplementary Material

### Novel perylene-bridged polyethyleneimine polymer networks: synthesis and photophysical–electrochemical insights for supercapacitor applications

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#### Contents

**Fig. S1** Synthetic pathway for the preparation of PEI-3 and PEI-5.

**Fig. S2** FTIR spectra of (a) compound 1, perylene-3,4,9,10-tetracarboxylic dianhydride (PDA), (b) compound 2, PEI 60 kDa, and (c) PEI-3, the perylene-cross-linked PEI 60 kDa network.

**Fig. S3** FTIR spectra of (a) compound 1, perylene-3,4,9,10-tetracarboxylic dianhydride (PDA), (b) compound 4, PEI 25 kDa, and (c) PEI-5, the perylene-cross-linked PEI 25 kDa network.

**Fig. S4** <sup>1</sup>H NMR spectrum of compound 2, PEI 60 kDa, in DMSO-d<sub>6</sub>.

**Fig. S5** <sup>1</sup>H NMR spectrum of PEI-3 in DMSO-d<sub>6</sub>.

**Fig. S6** <sup>1</sup>H NMR spectrum of compound 4, PEI 25 kDa, in DMSO-d<sub>6</sub>.

**Fig. S7** <sup>1</sup>H NMR spectrum of PEI-5 in DMSO-d<sub>6</sub>.

**Fig. S8** Photographs of PEI-3 and PEI-5 solutions/dispersions in solvents of different polarity under daylight (left) and 365 nm UV irradiation (right).

**Fig. S9** TEM images of PEI-3 and PEI-5 powders.

**Fig. S10** b-value analysis plots of PEI-3 and PEI-5 electrodes obtained from the relationship between log(i) and log(v) at selected potentials.

**Fig. S11** (a) CV curves of the PEI-3 symmetric supercapacitor device recorded at 100 mV s<sup>-1</sup> over different potential windows and (b) GCD profiles recorded at different potential windows at a current density of 1 A g<sup>-1</sup>.

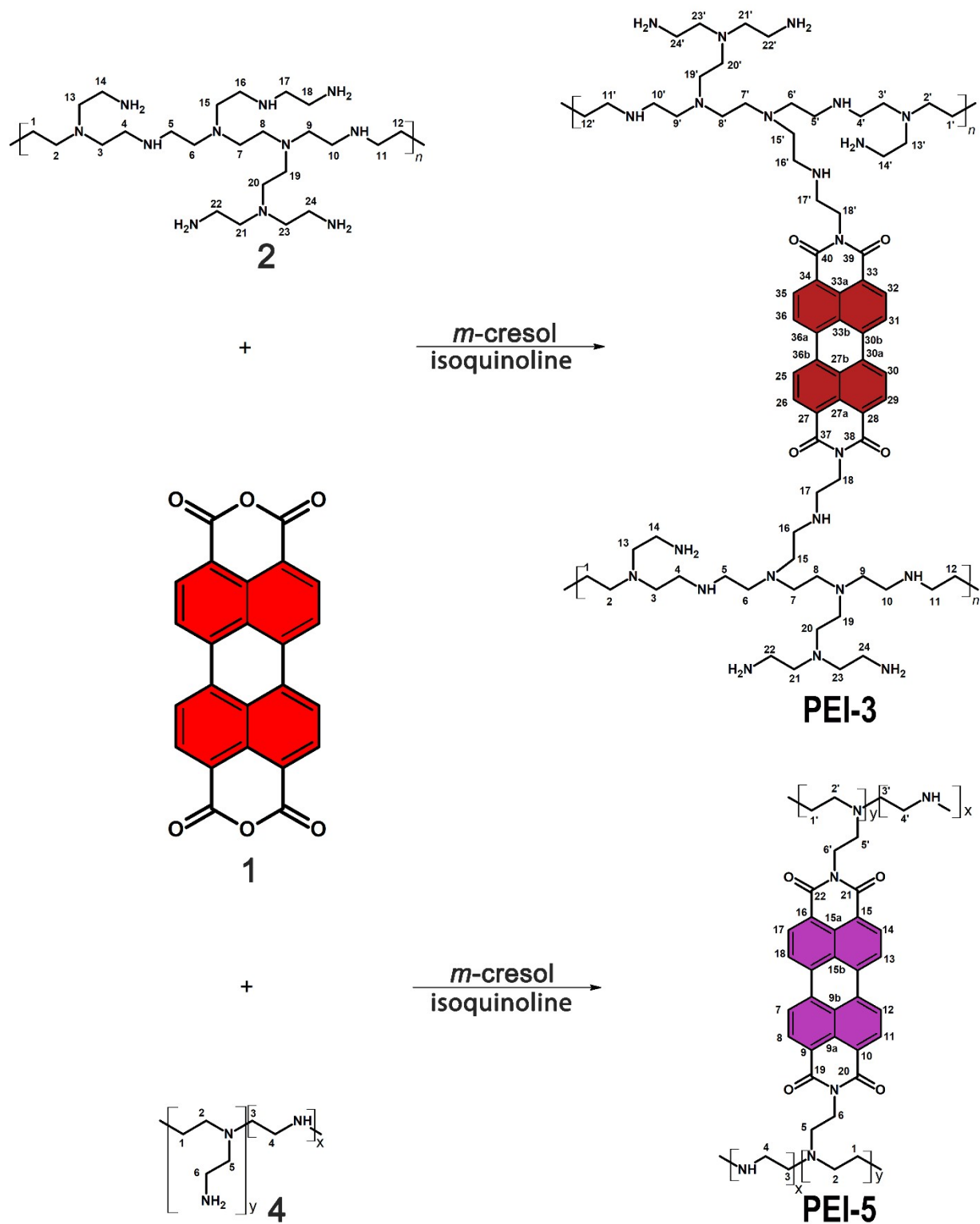
**Fig. S12** Coulombic efficiency of the PEI-3 symmetric supercapacitor device at different current densities.

**Table S1** Qualitative solubility and colour changes of PEI-3 and PEI-5 in various organic solvents.

**Table S2** Absorption intensity ratios of PEI-3 and PEI-5 in different solvents.

**Table S3** Maximum absorption wavelength  $\lambda_{\text{max}}$  (nm), half-width  $\Delta\bar{\nu}_{1/2}$  (cm<sup>-1</sup>), fluorescence quantum yield  $\Phi_f$ , and singlet energy  $E_s$  (kcal mol<sup>-1</sup>) data of PEI-3 and PEI-5 in different organic solvents

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**Fig. S1** Synthetic pathway for the preparation of PEI-3 and PEI-5.

**Table S1** Qualitative solubility and colour changes of PEI-3 and PEI-5 in various organic solvents.

Solvent	PEI-3	PEI-5
CHL <sup>b</sup>	(+-)/ purple	(+-)/ purple
EtOAc <sup>c</sup>	(-)	(-)
AcOH <sup>d</sup>	(+-)/ dark red	(+-)/ dark purple
THF <sup>e</sup>	(-)	(-)
TCE <sup>f</sup>	(+-)/ light purple	(+-)/ light purple
TFAc <sup>g</sup>	(+-)/ dark red	(+-)/ dark purple
DCM <sup>h</sup>	(-)	(-)
PYR <sup>i</sup>	(+-)/ light purple	(+-)/ light purple
IPA <sup>j</sup>	(+-)/ light purple	(+-)/ light purple
ACE <sup>k</sup>	(-)	(-)
EtOH <sup>l</sup>	(-)	(-)
NMP <sup>m</sup>	(+-)/ bordeaux	(+-)/ purple
MeOH <sup>n</sup>	(-)	(-)
DMF <sup>o</sup>	(+-)/ pink	(+-)/ purple
CH <sub>3</sub> CN <sup>p</sup>	(-)	(-)
DMAc <sup>r</sup>	(+-)/ pink	(+-)/ purple
DMSO <sup>s</sup>	(+-)/ bordeaux	(+-)/ purple
H <sub>2</sub> O <sup>t</sup>	(-)	(-)

<sup>a</sup>Measured at a concentration of 1 mg mL<sup>-1</sup> in solvents at 25 °C. (++) : soluble; (+-) : partially soluble (0.2 – 0.7 mg ml<sup>-1</sup>); (-) : insoluble.

<sup>b</sup>CHL: Chloroform.

<sup>c</sup>EtOAc: Ethyl acetate.

<sup>d</sup>AcOH: Acetic acid

<sup>e</sup>THF: Tetrahydrofuran.

<sup>f</sup>TCE: 1,1,2,2- tetrachloroethane.

<sup>g</sup>TFAc: Tetrafluoroacetic acid.

<sup>h</sup>DCM: Dichloromethane.

<sup>i</sup>PYR: Pyridine.

<sup>j</sup>IPA: Isopropanol.

<sup>k</sup>Ace: Acetone.

<sup>l</sup>EtOH: Ethanol

<sup>m</sup>NMP: *N*-methyl-2-pyrrolidinone.

<sup>n</sup>MeOH: Methanol

<sup>o</sup>DMF: *N,N*-dimethylformamide.

<sup>p</sup>CH<sub>3</sub>CN: Acetonitrile.

<sup>r</sup>DMAc: *N,N*-dimethylacetamide.

<sup>s</sup>DMSO: Dimethyl sulfoxide.

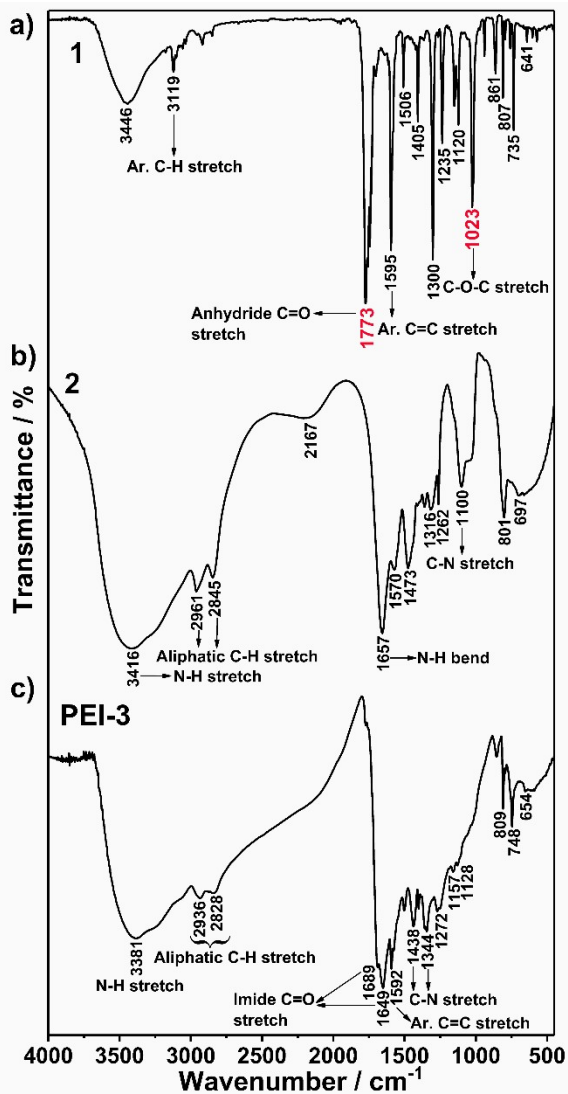
<sup>t</sup>H<sub>2</sub>O: Water.

**Table S2** Absorption intensity ratios of PEI-3 and PEI-5 in different solvents.

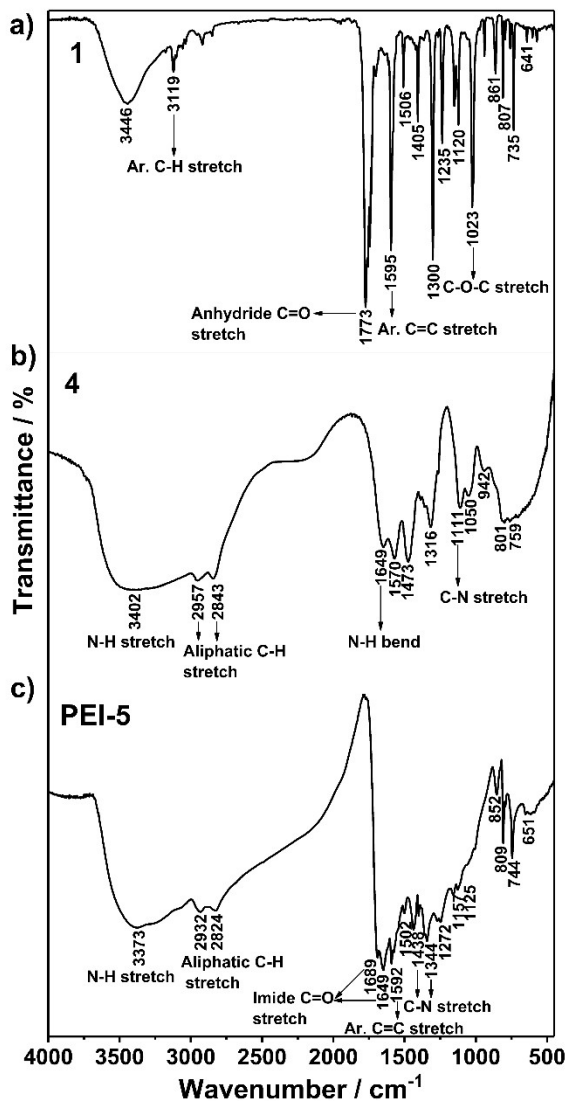
Solvent	$A^{0\rightarrow 0}$		$A^{0\rightarrow 1}$		$A^{0\rightarrow 0}/A^{0\rightarrow 1}$	
	PEI-3	PEI-5	PEI-3	PEI-5	PEI-3	PEI-5
AcOH	1.46	0.74	1.32	0.59	1.11	1.25
NMP	1.31	0.72	1.16	0.55	1.13	1.31
DMF	1.12	0.62	0.94	0.44	1.19	1.41
DMAc	0.63	0.21	0.54	0.15	1.17	1.4
DMSO	1.42	0.084	1.32	0.06	1.08	1.4

**Table S3** Maximum absorption wavelength  $\lambda_{max}$  (nm), half-width  $\Delta\bar{\nu}_{1/2}$  (cm<sup>-1</sup>), fluorescence quantum yield  $\Phi_f$ , and singlet energy  $E_s$  (kcal mol<sup>-1</sup>) data of PEI-3 and PEI-5 in different organic solvents

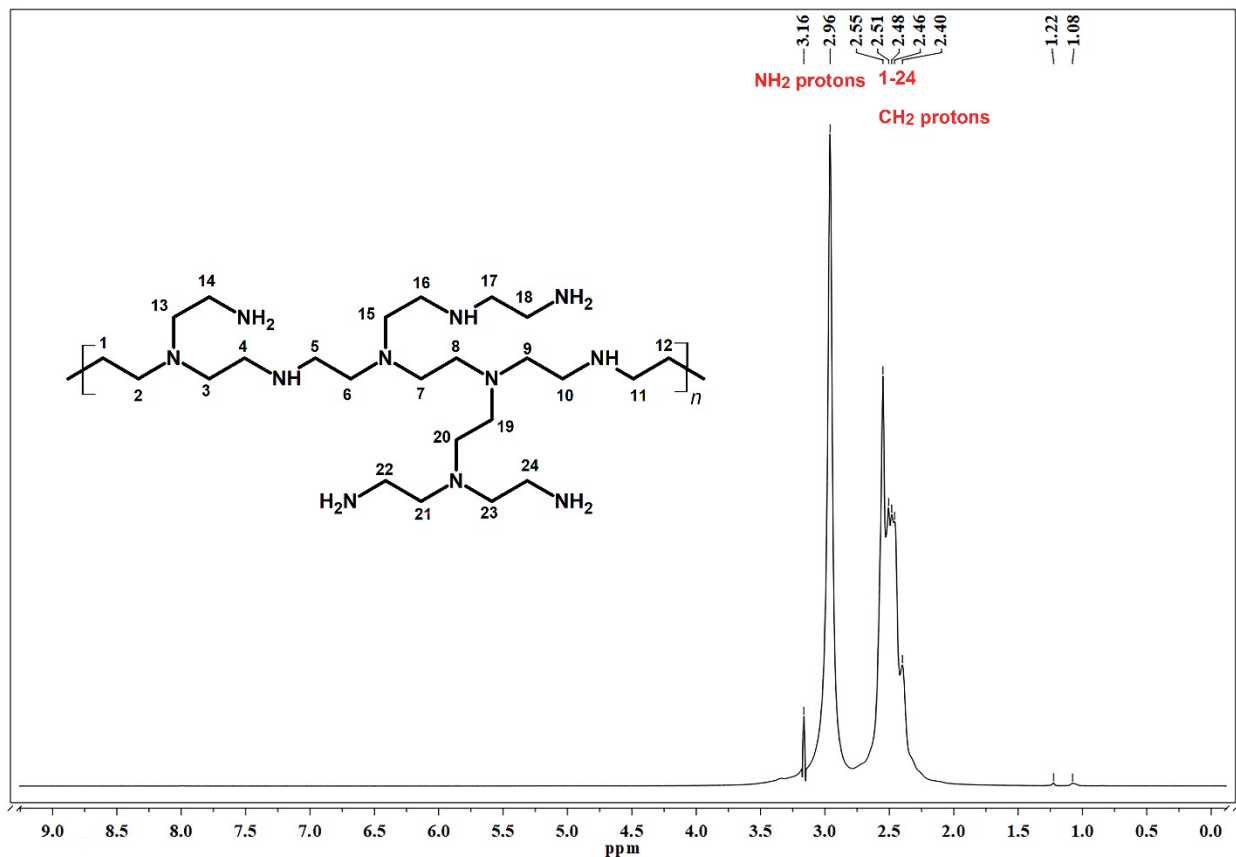
Compound	Solvent	$\lambda_{max}$	$\Delta\bar{\nu}_{1/2}$	$\Phi_f$	$E_s$
PEI-3	AcOH	526	1673.32	-	54.37
	NMP	525	1559.73	0.24	54.48
	DMF	524	1425.06	0.32	54.58
	DMAc	524	1758.09	-	54.58
	DMSO	526	1646.90	-	54.37
PEI-5	AcAc	525	1920.12	-	54.48
	NMP	525	1632.54	0.15	54.48
	DMF	524	1537.97	0.28	54.58
	DMAc	524	1571.69	-	54.58
	DMSO	526	1559.73	-	54.37



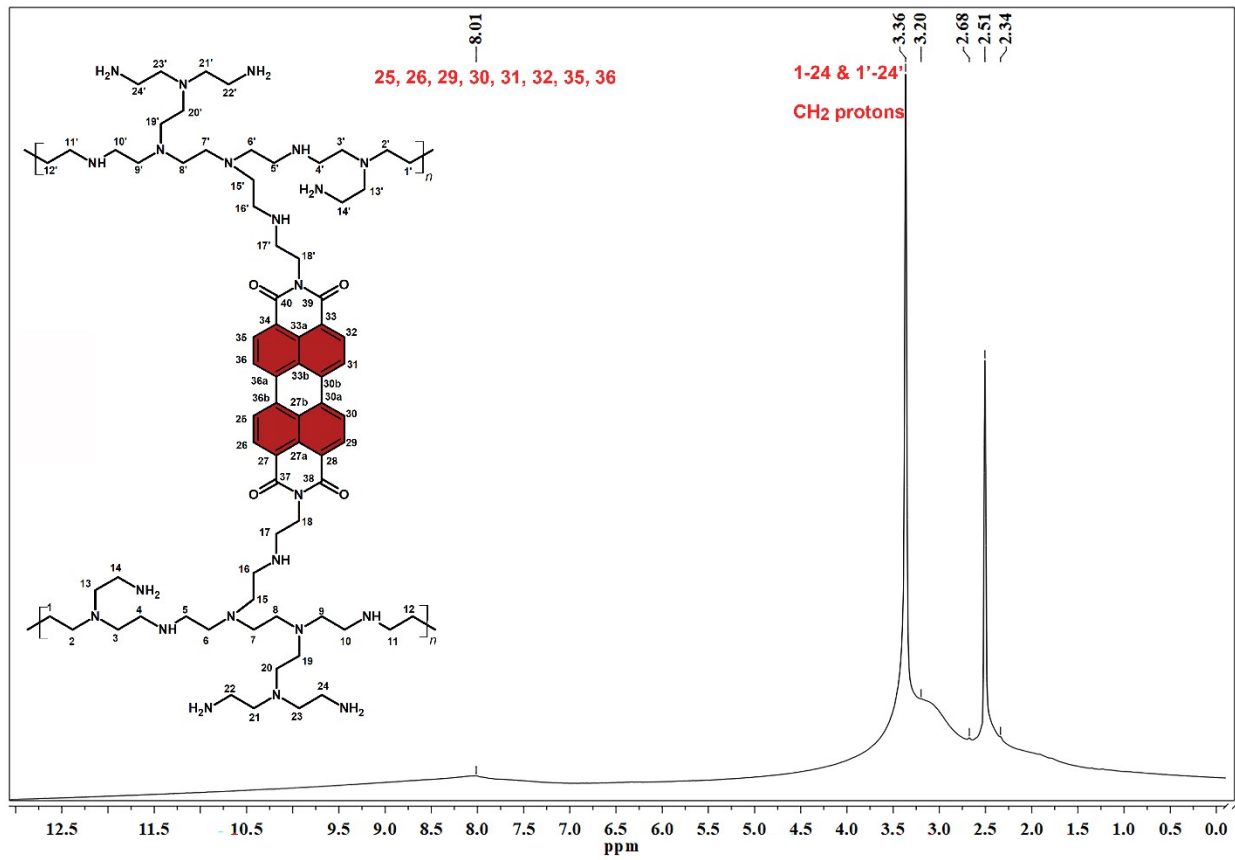
**Fig. S2** FTIR spectra of (a) compound 1, perylene-3,4,9,10-tetracarboxylic dianhydride (PDA), (b) compound 2, PEI 60 kDa, and (c) PEI-3, the perylene-cross-linked PEI 60 kDa network.



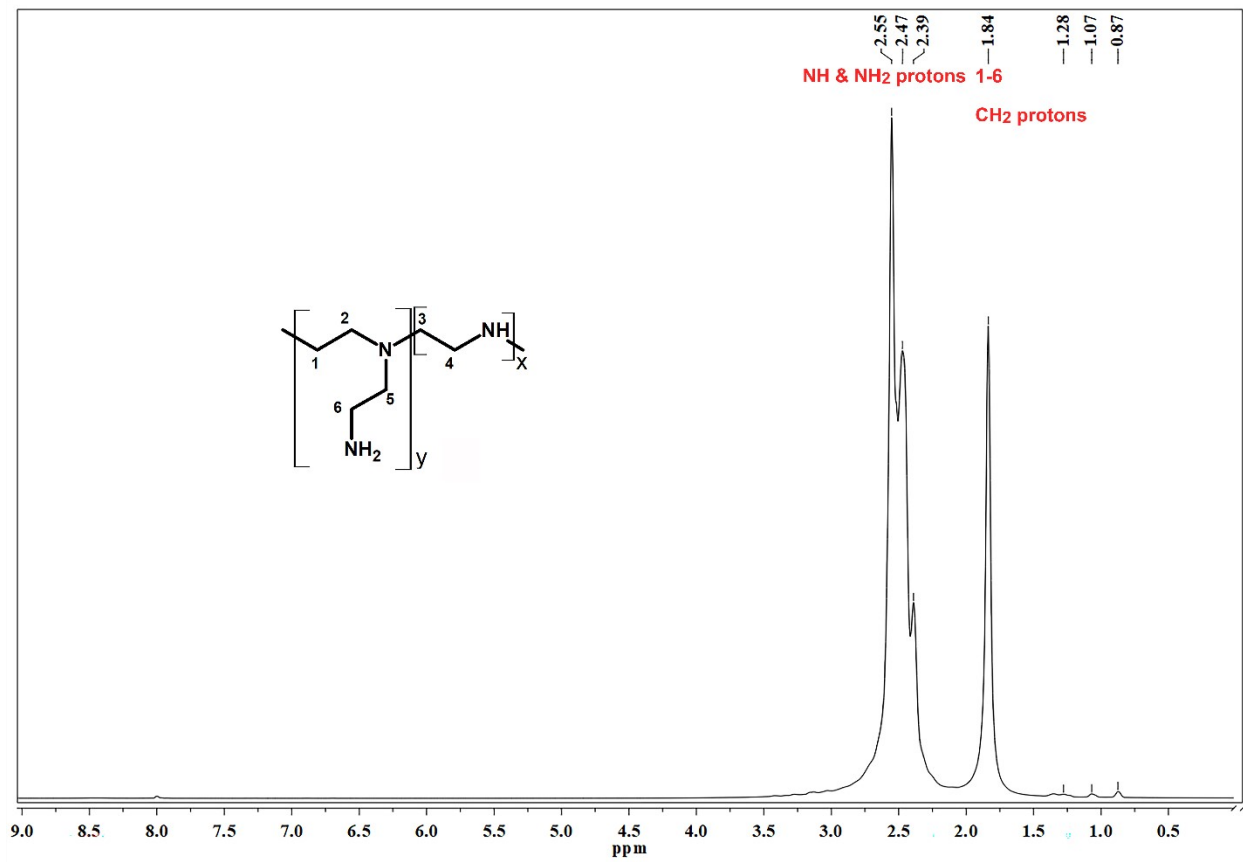
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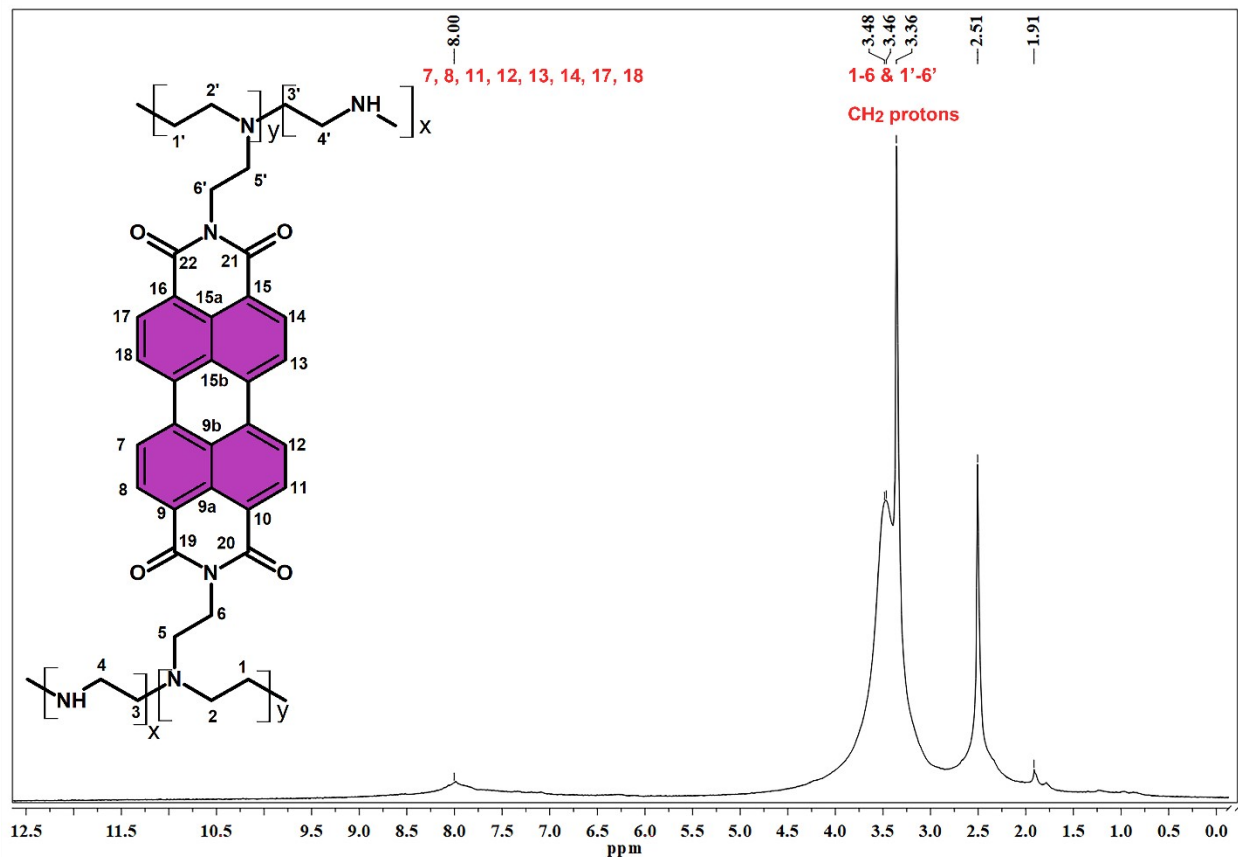
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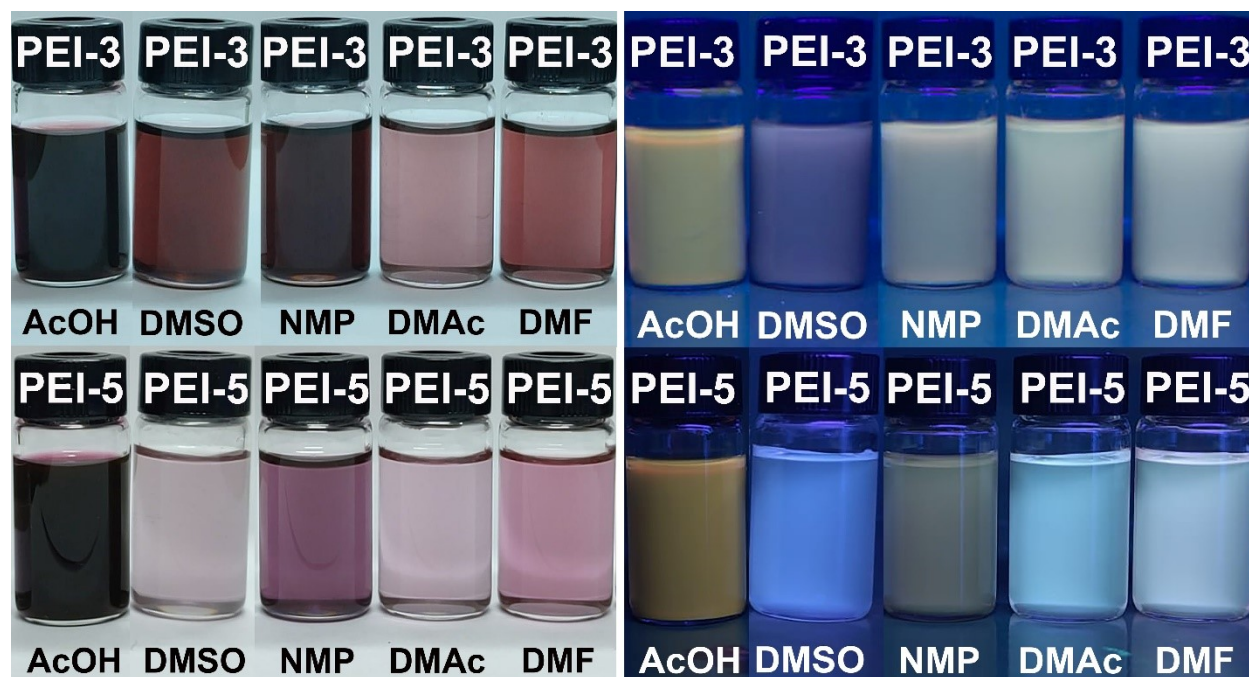
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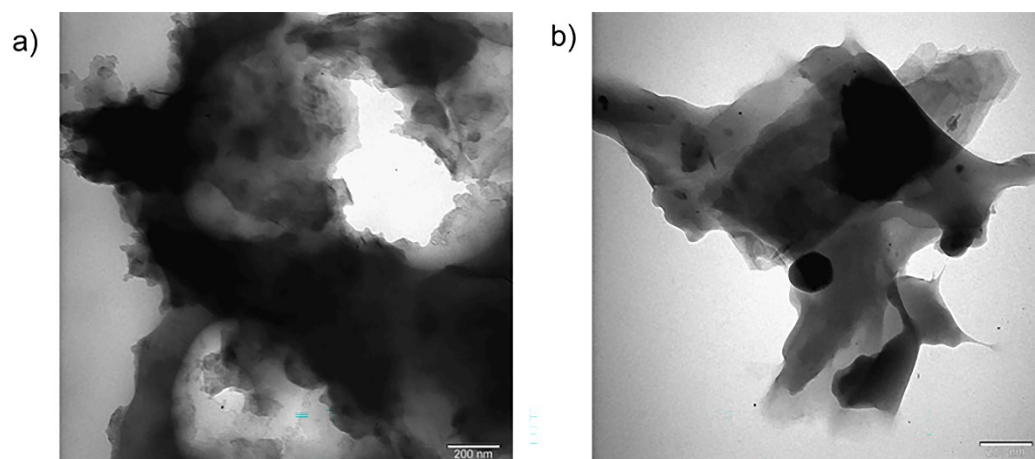
**Fig. S6**  $^1\text{H}$  NMR spectrum of compound 4, PEI 25 kDa, in  $\text{DMSO-d}_6$ .



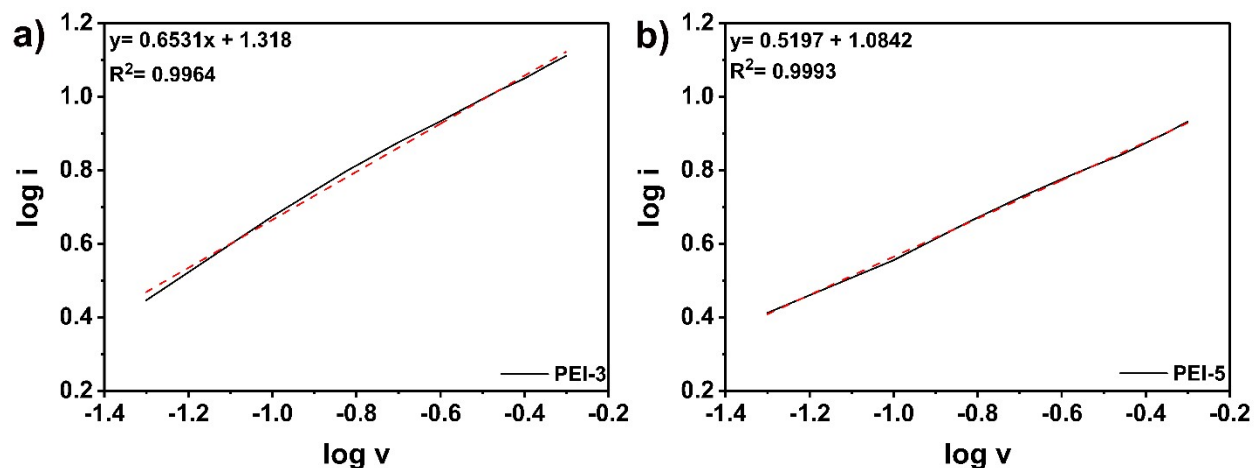
**Fig. S7**  $^1\text{H}$  NMR spectrum of PEI-5 in  $\text{DMSO-d}_6$ .



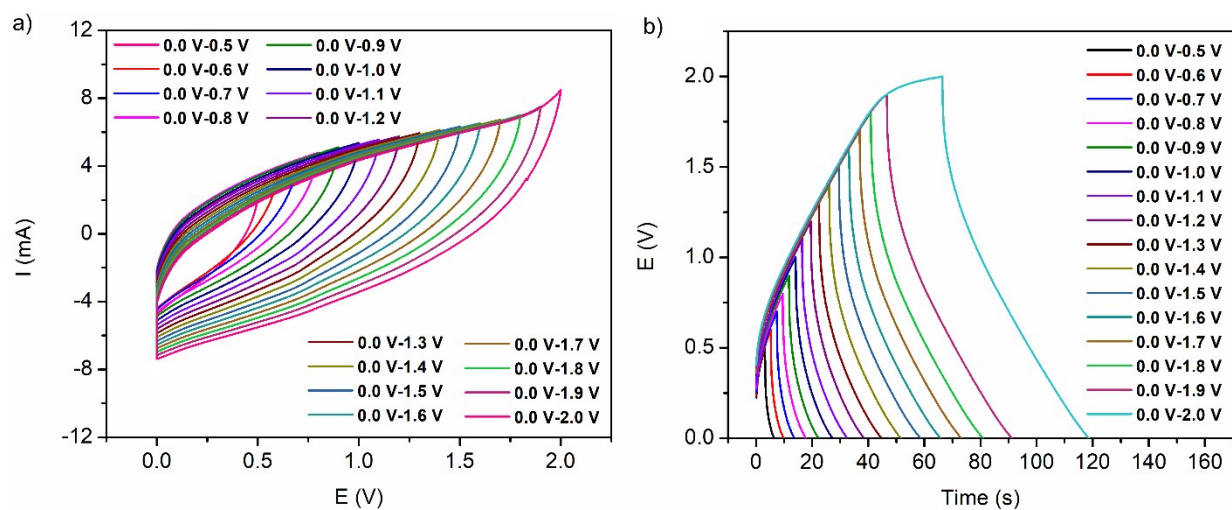
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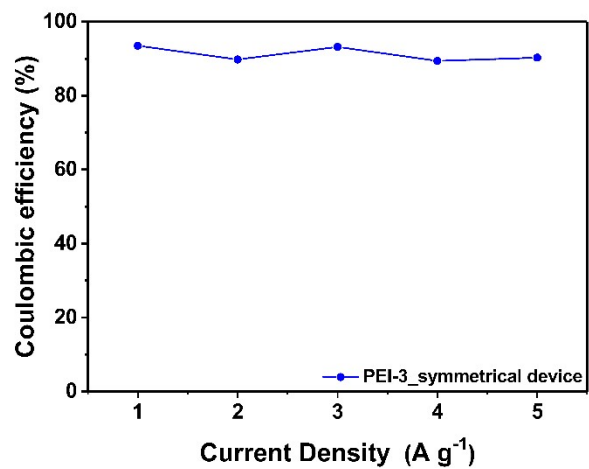
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**Table S4** Comparison of the electrochemical performance of the PEI–perylene symmetric supercapacitor device with previously reported perylene/PDI-based supercapacitor systems.

PPAC/PDI-1//PPAC	0.5 A g <sup>-1</sup>	617 F g <sup>-1</sup>	1 M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1016/j.est.2022.106058">https://doi.org/10.1016/j.est.2022.106058</a>
PDI-Pyr/GF//PDI-Pyr/GF	1 A g <sup>-1</sup>	92 F g <sup>-1</sup>	1 M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1016/j.ceja.2023.100499">https://doi.org/10.1016/j.ceja.2023.100499</a>
PDI-PDA-rGO/rGO ASC	1 A g <sup>-1</sup>	310 F g <sup>-1</sup>	1M Na <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1002/cssc.202000440">https://doi.org/10.1002/cssc.202000440</a>
PDI-Py/GF//PDI-Py/GF	1 A g <sup>-1</sup>	128 F g <sup>-1</sup>	1 M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1002/ente.202200154">https://doi.org/10.1002/ente.202200154</a>
PEDOT/PDI film	0.5 A g <sup>-1</sup>	78.6 F g <sup>-1</sup>	0.1 M TBAPF6 gel electrolyte	<a href="https://doi.org/10.1021/acsapm.0c00905">https://doi.org/10.1021/acsapm.0c00905</a>
2-AP PDI based cell	1 A g <sup>-1</sup>	41.56 F g <sup>-1</sup>	1M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1016/j.jpowsour.2025.236781">https://doi.org/10.1016/j.jpowsour.2025.236781</a>
Cell 5	0.01A g <sup>-1</sup>	61.95 F g <sup>-1</sup>	1 M H <sub>3</sub> PO <sub>4</sub>	<a href="https://doi.org/10.1021/acsaelm.4c02164">https://doi.org/10.1021/acsaelm.4c02164</a>
PDI-NDI-PDI /GF// PDI-NDI-PDI /GF	0.5 A g <sup>-1</sup>	193.33 F g <sup>-1</sup>	1M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1016/j.est.2024.111874">https://doi.org/10.1016/j.est.2024.111874</a>
NH-PDI	0.5 A g <sup>-1</sup>	134.2 F g <sup>-1</sup>	1M H <sub>2</sub> SO <sub>4</sub>	<a href="https://doi.org/10.1039/D4TA06278G">https://doi.org/10.1039/D4TA06278G</a>
<b>PEI-3_symmetrical device</b>	<b>1.0 A g<sup>-1</sup></b>	<b>107 F g<sup>-1</sup></b>	<b>1M H<sub>2</sub>SO<sub>4</sub></b>	<b>This work</b>