# Supplementary Information

## Designing neurotransmitter dopamine functionalized naphthalene diimide molecular architectures for high-performance organic supercapacitor electrode materials

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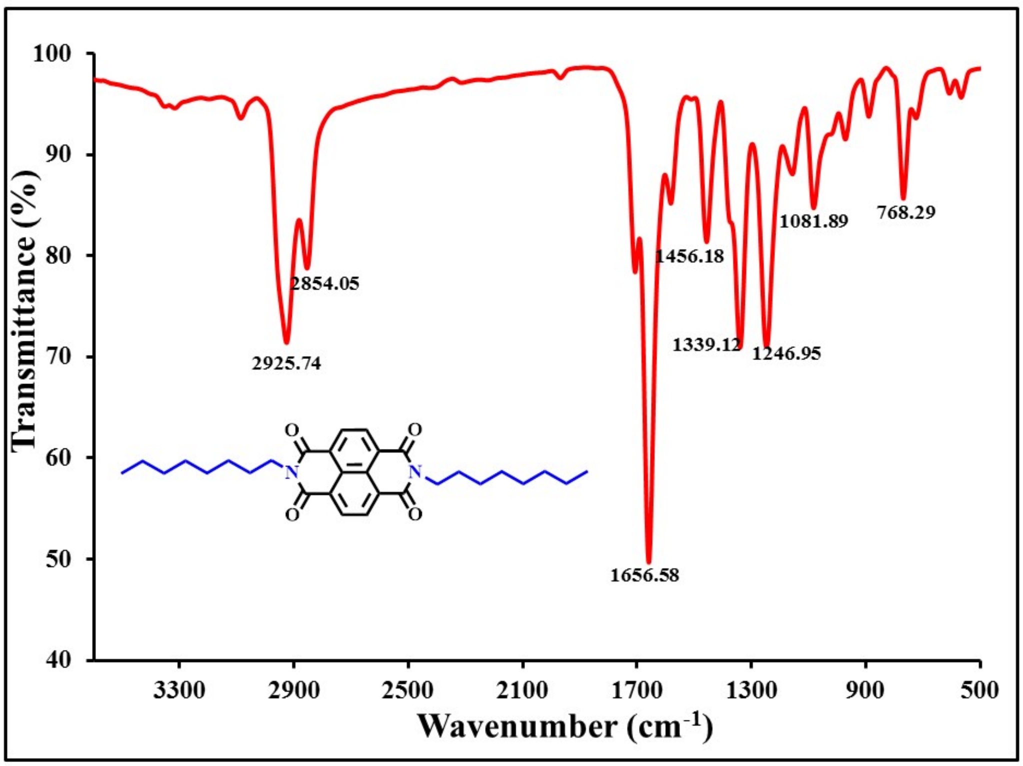


**Fig. S1** FT-IR spectra of **NDI**.

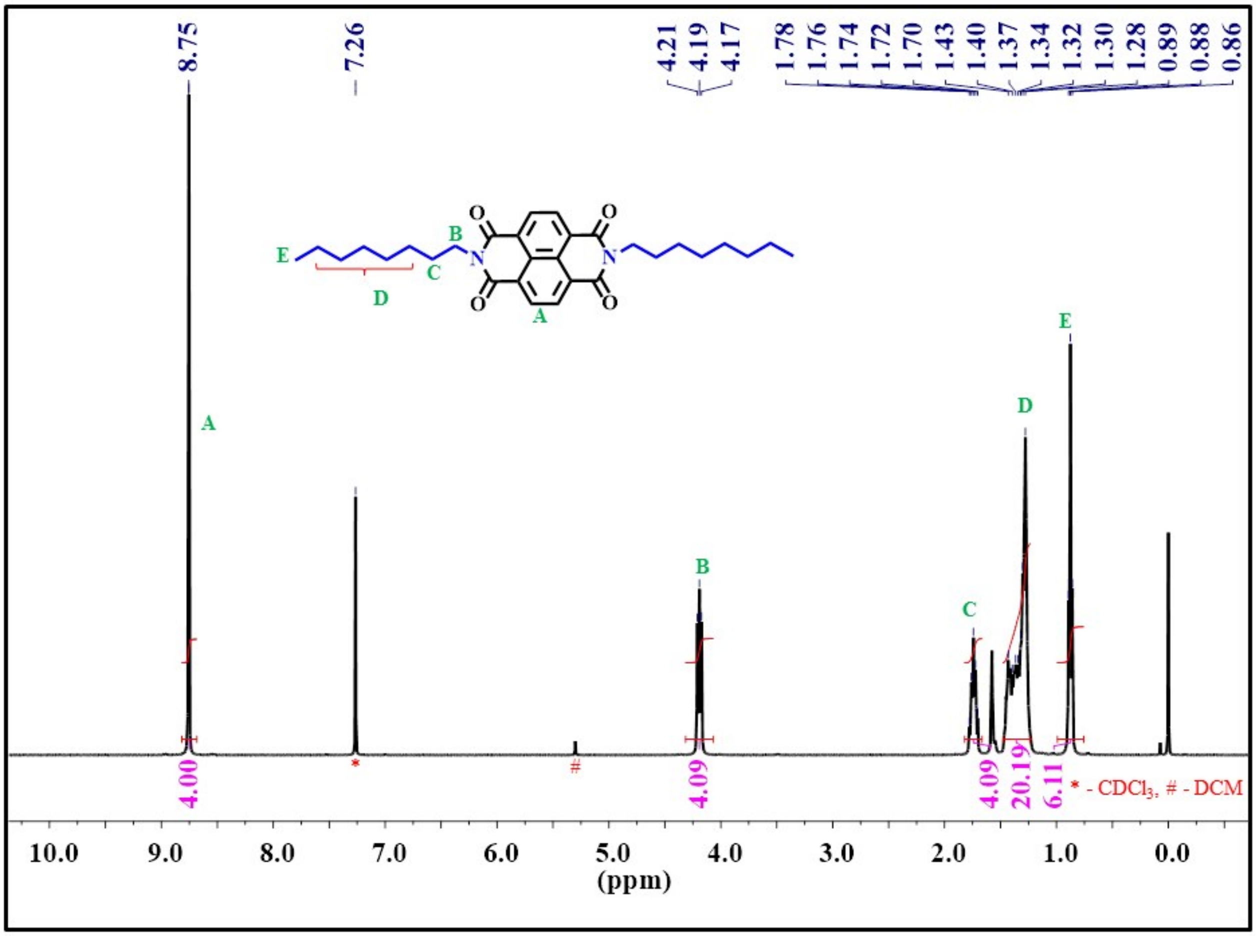


**Fig. S2** [1]H NMR spectra of **NDI**.

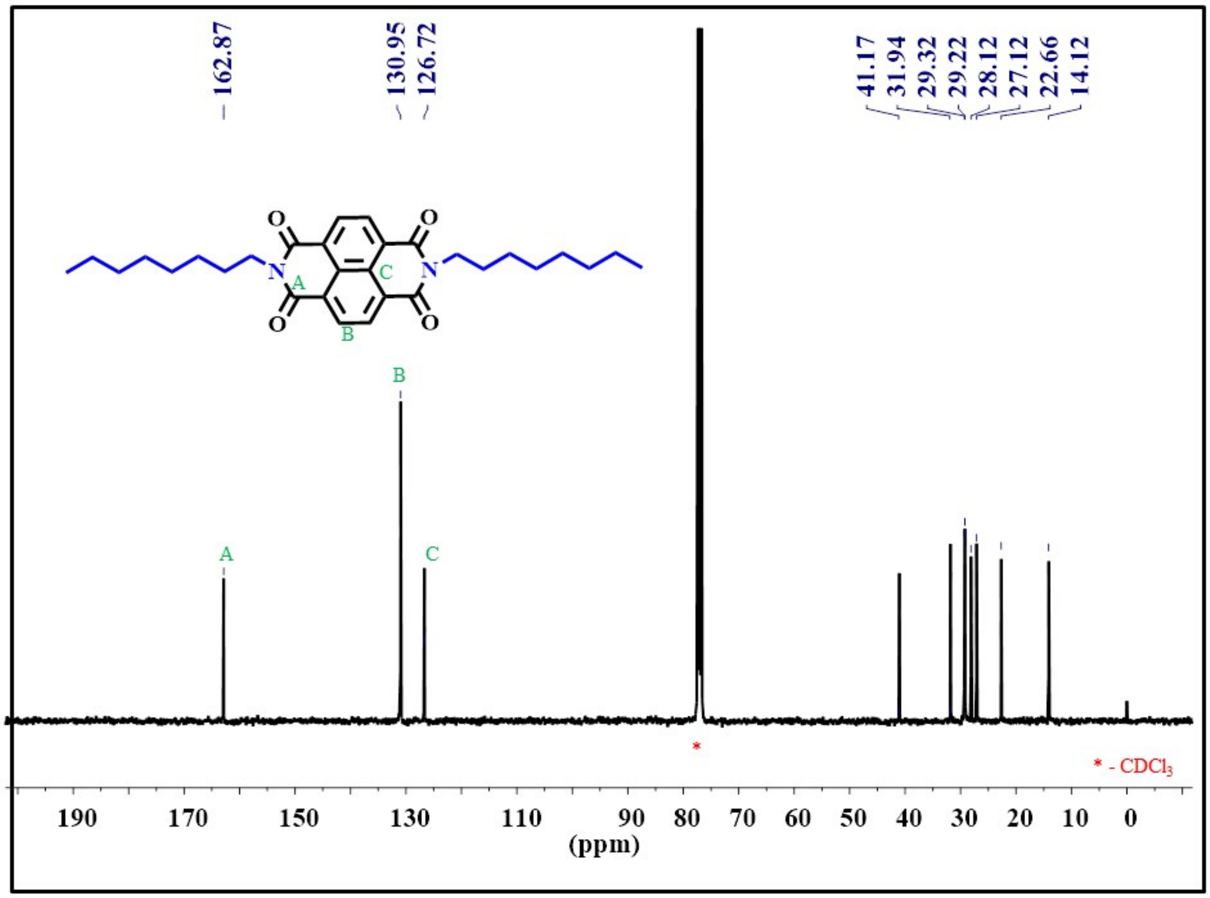


**Fig. S3** $^{13}$C NMR spectra of **NDI.**

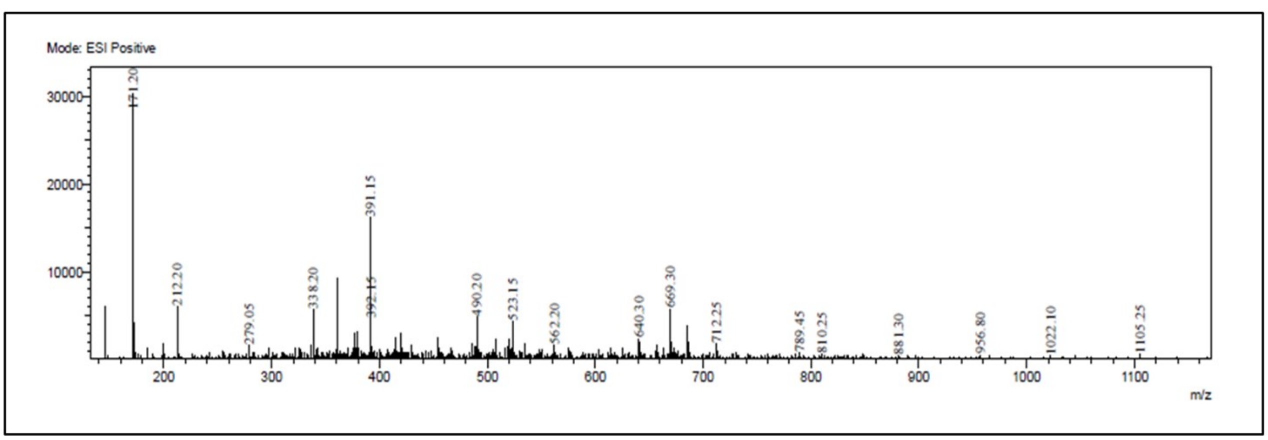


**Fig. S4** LR-MS spectrum of **NDI**.

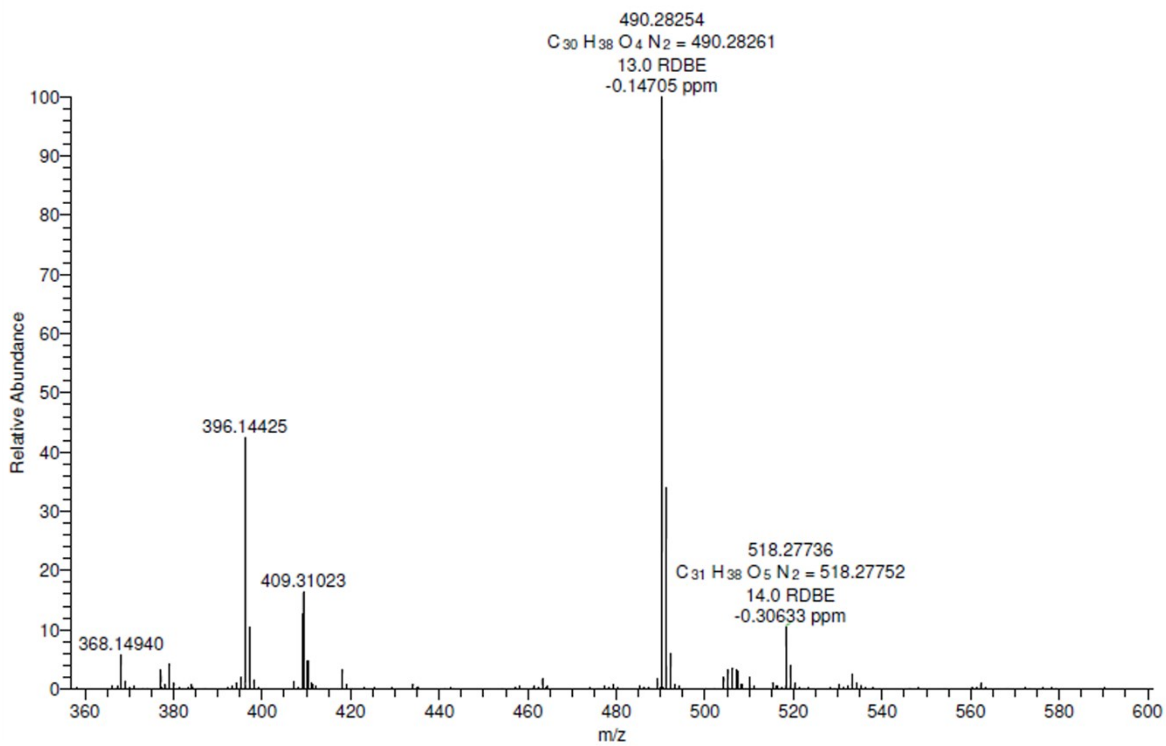


**Fig. S5** HRMS spectrum of NDI

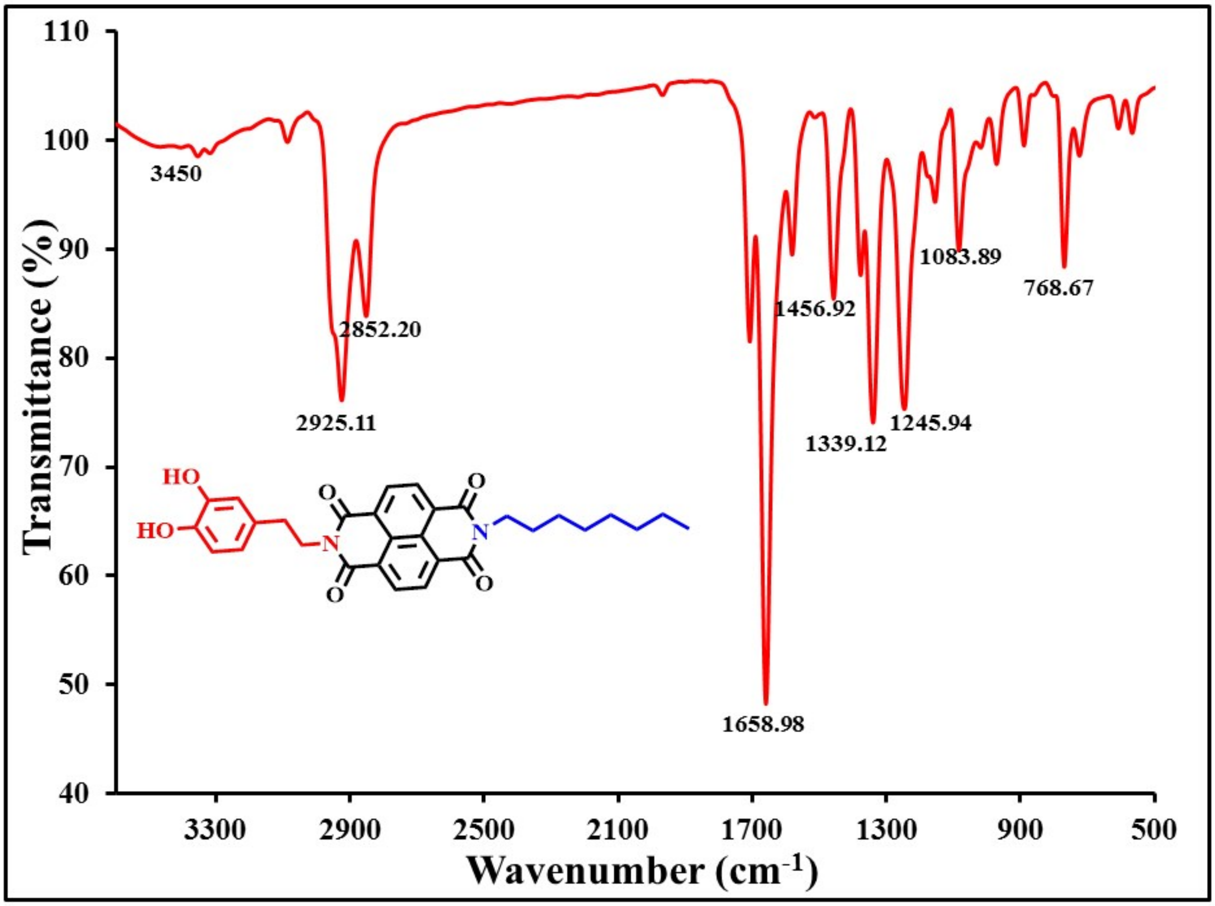


**Fig. S6** FT-IR spectra of **NDI-1DP**.

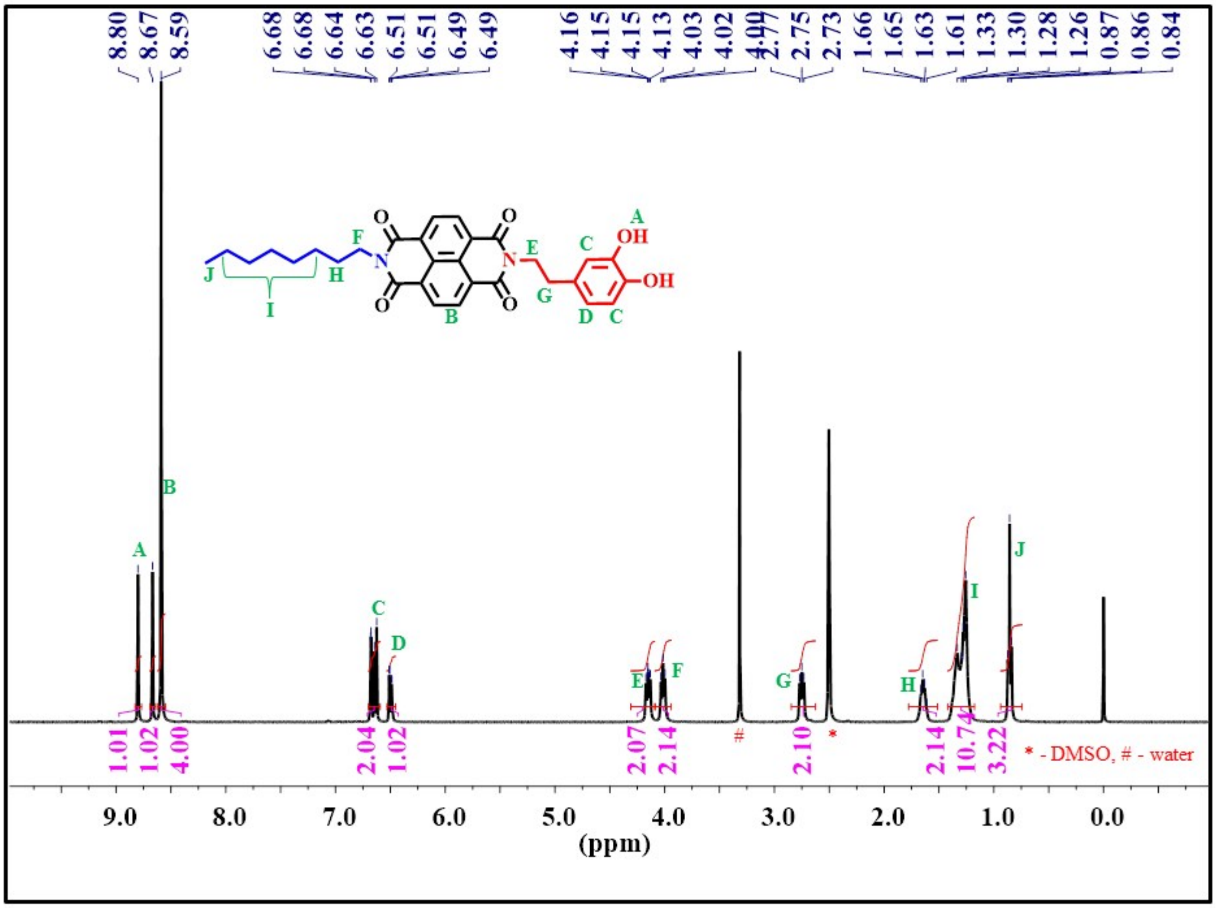


**Fig. S7** [1]H NMR spectra of **NDI-1DP**.

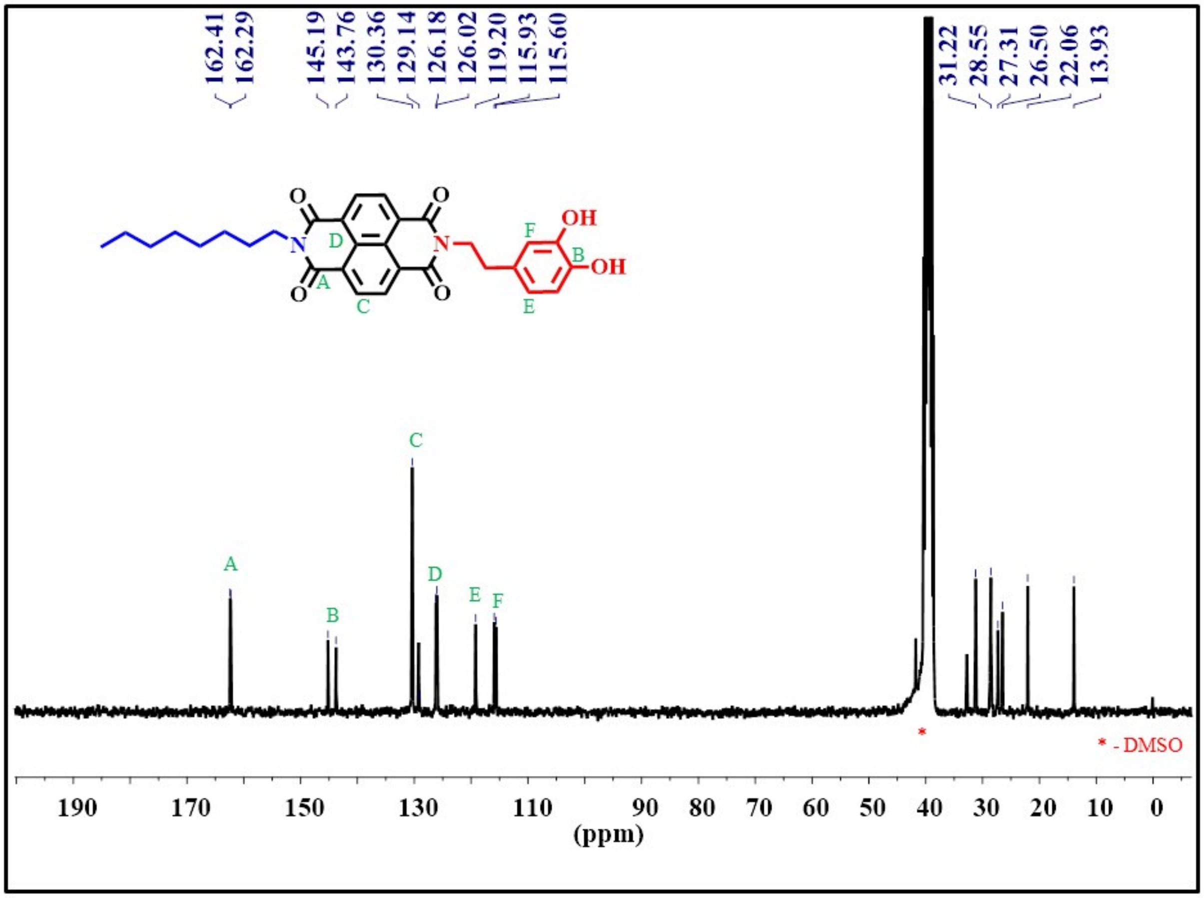


**Fig. S8** [13]C NMR spectra of **NDI-1DP**.

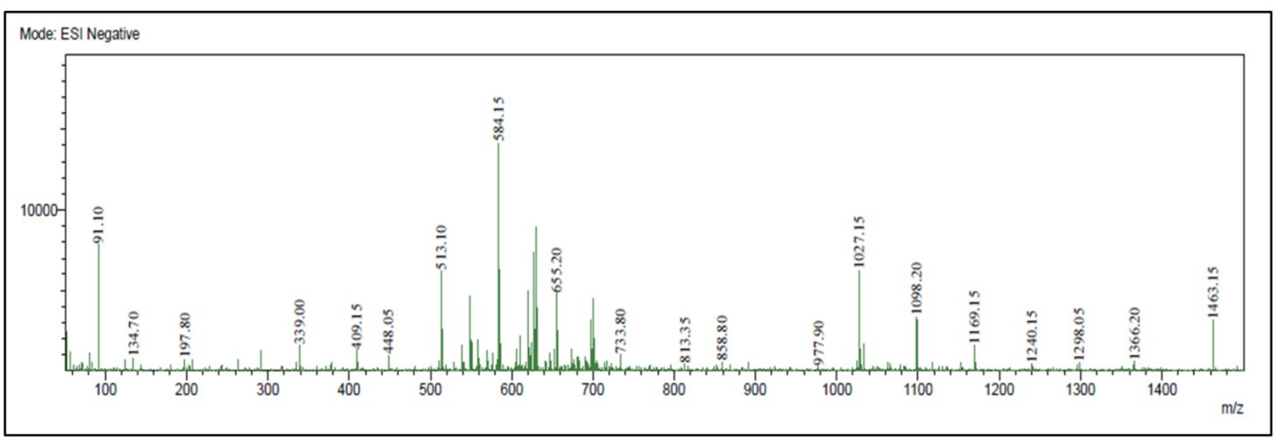


**Fig. S9** LR-MS (negative mode) spectrum of **NDI-1DP**.

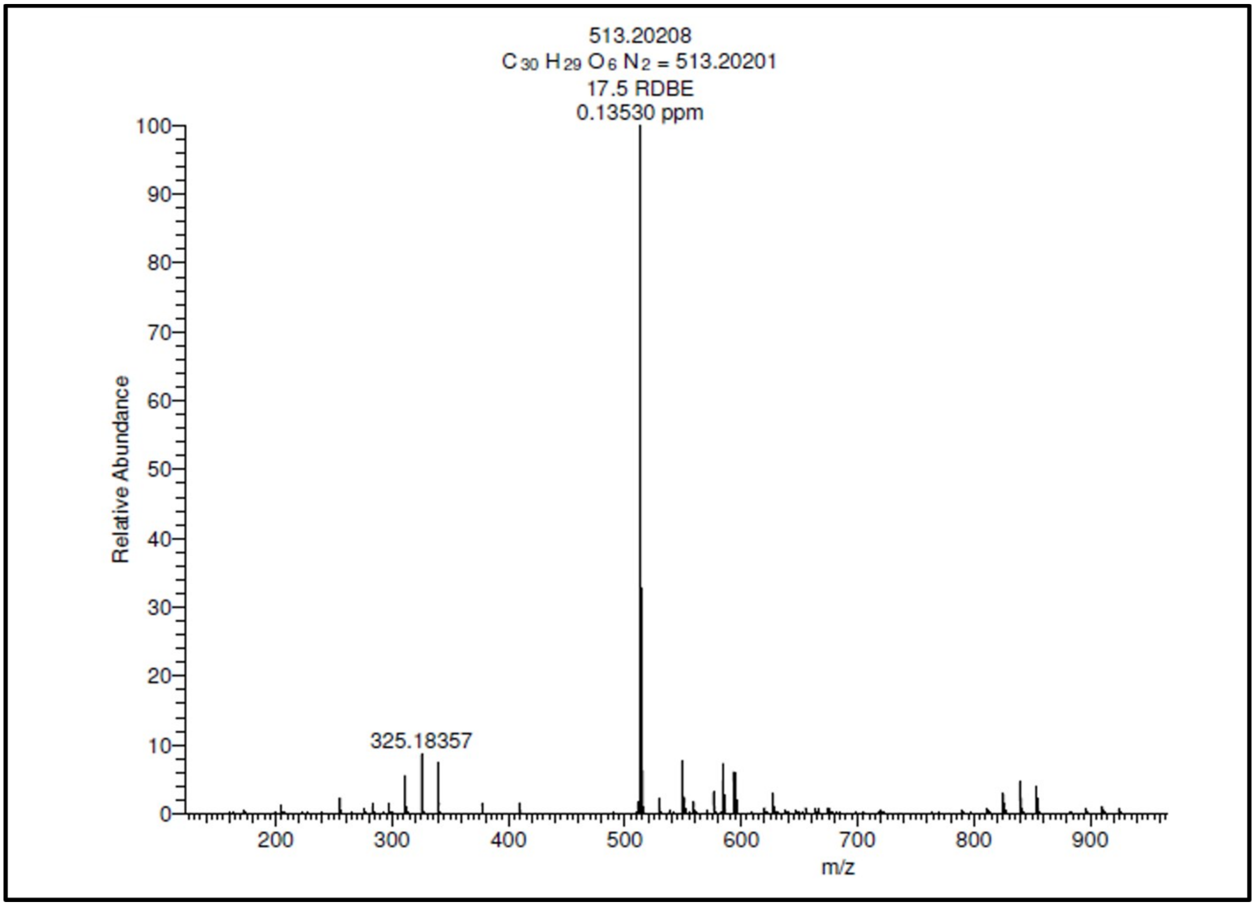


**Fig. S10** HRMS spectrum of NDI-1DP

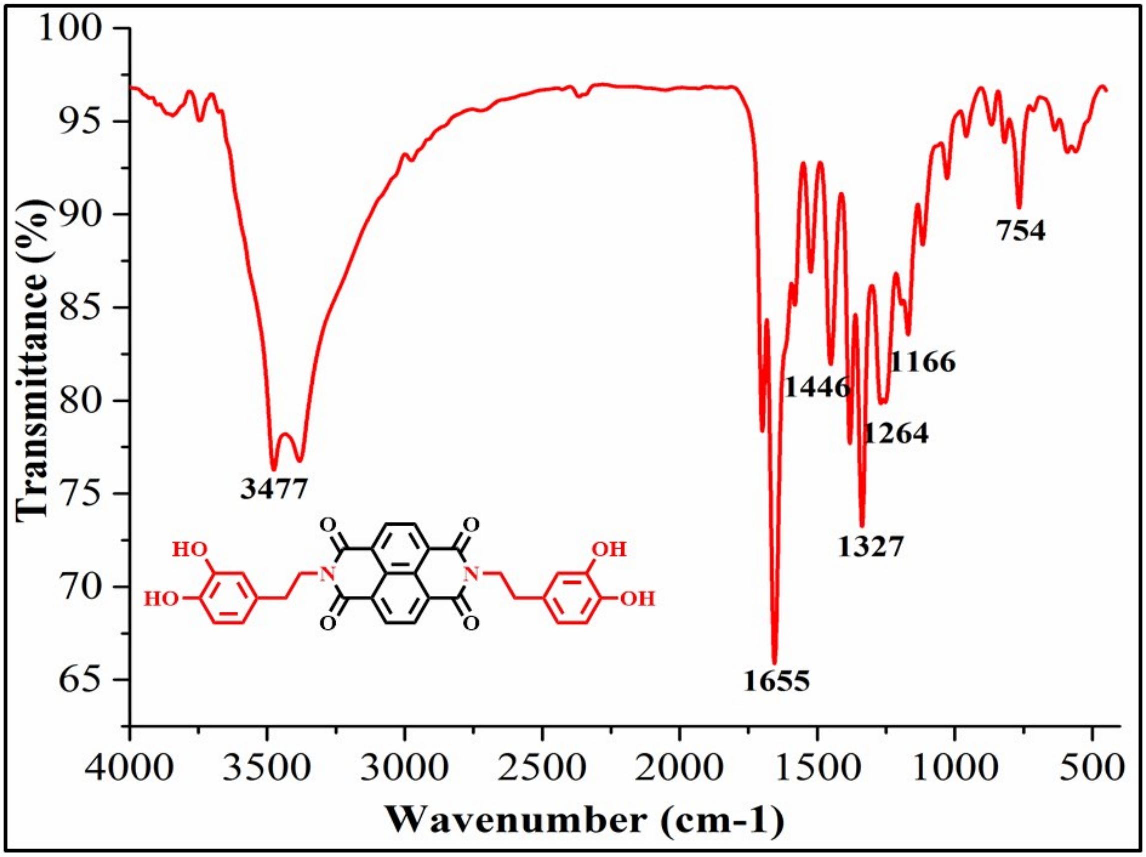


**Fig. S11** FT-IR spectra of NDI-2DP.

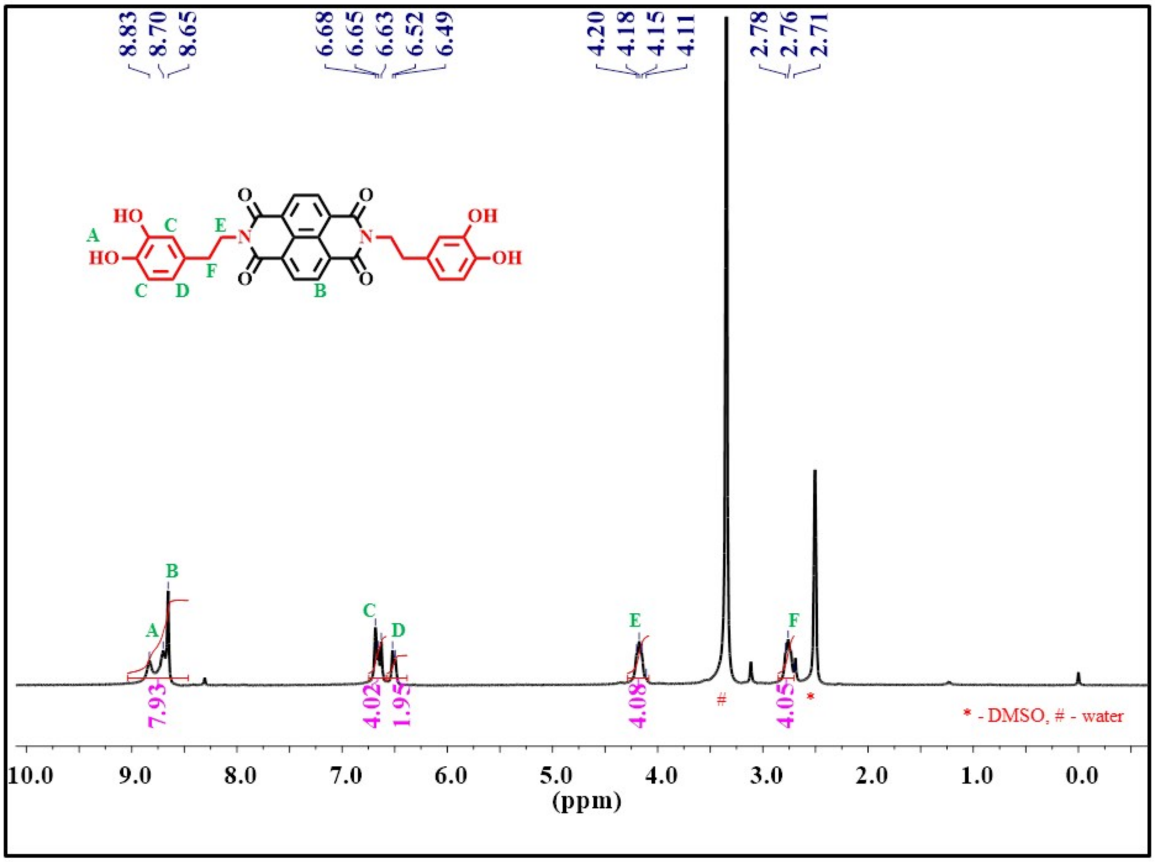


**Fig. S12** $^{1}$H NMR spectra of **NDI-2DP**.

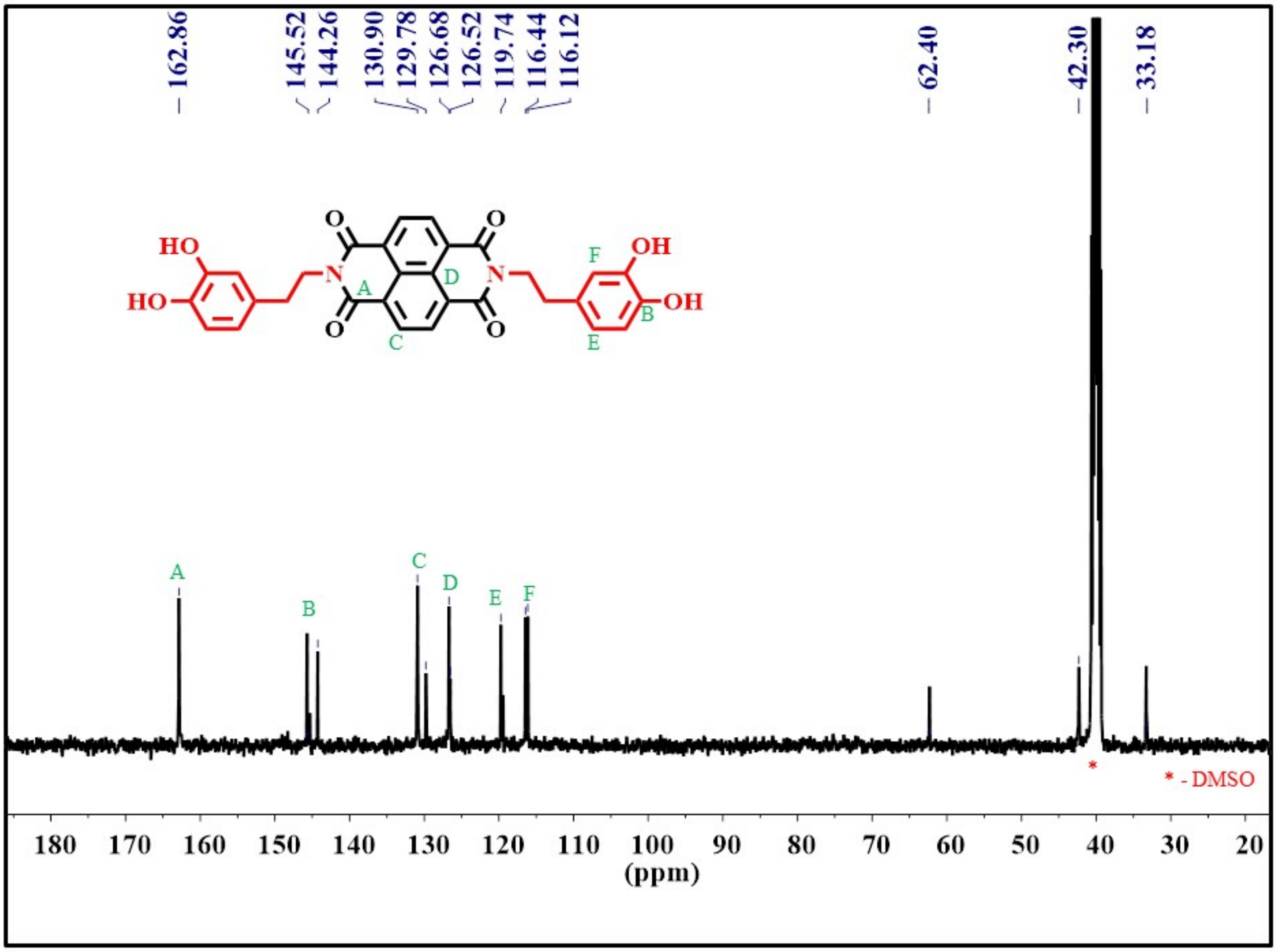


**Fig. S13** $^{13}$C NMR spectra of **NDI-2DP**.

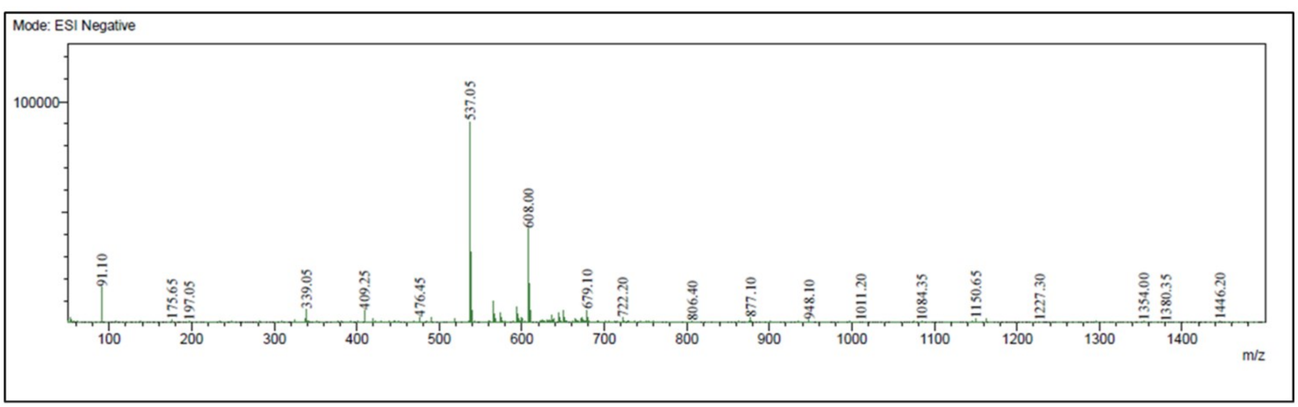


**Fig. S14** LR-MS (negative mode) spectrum of **NDI-2DP**.

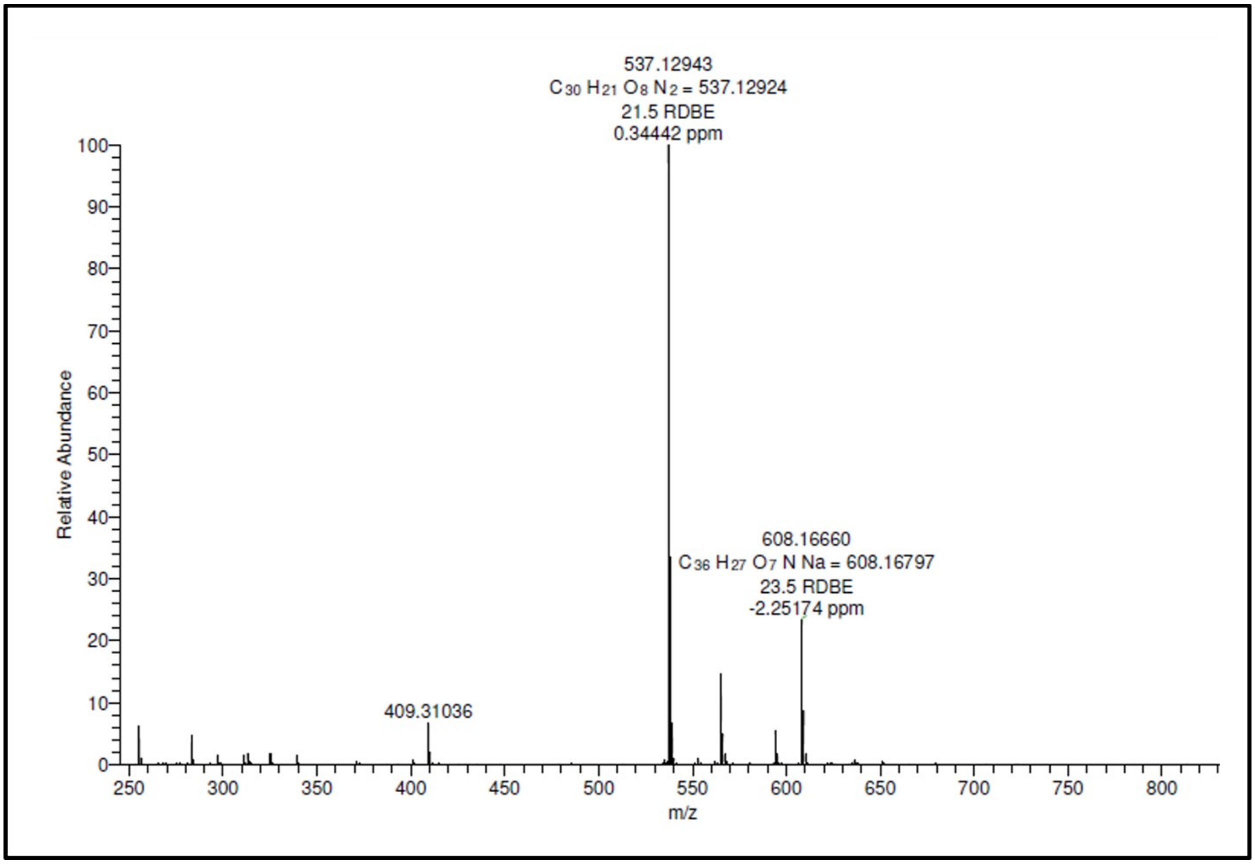


**Fig. S15** HRMS spectrum of NDI-2DP

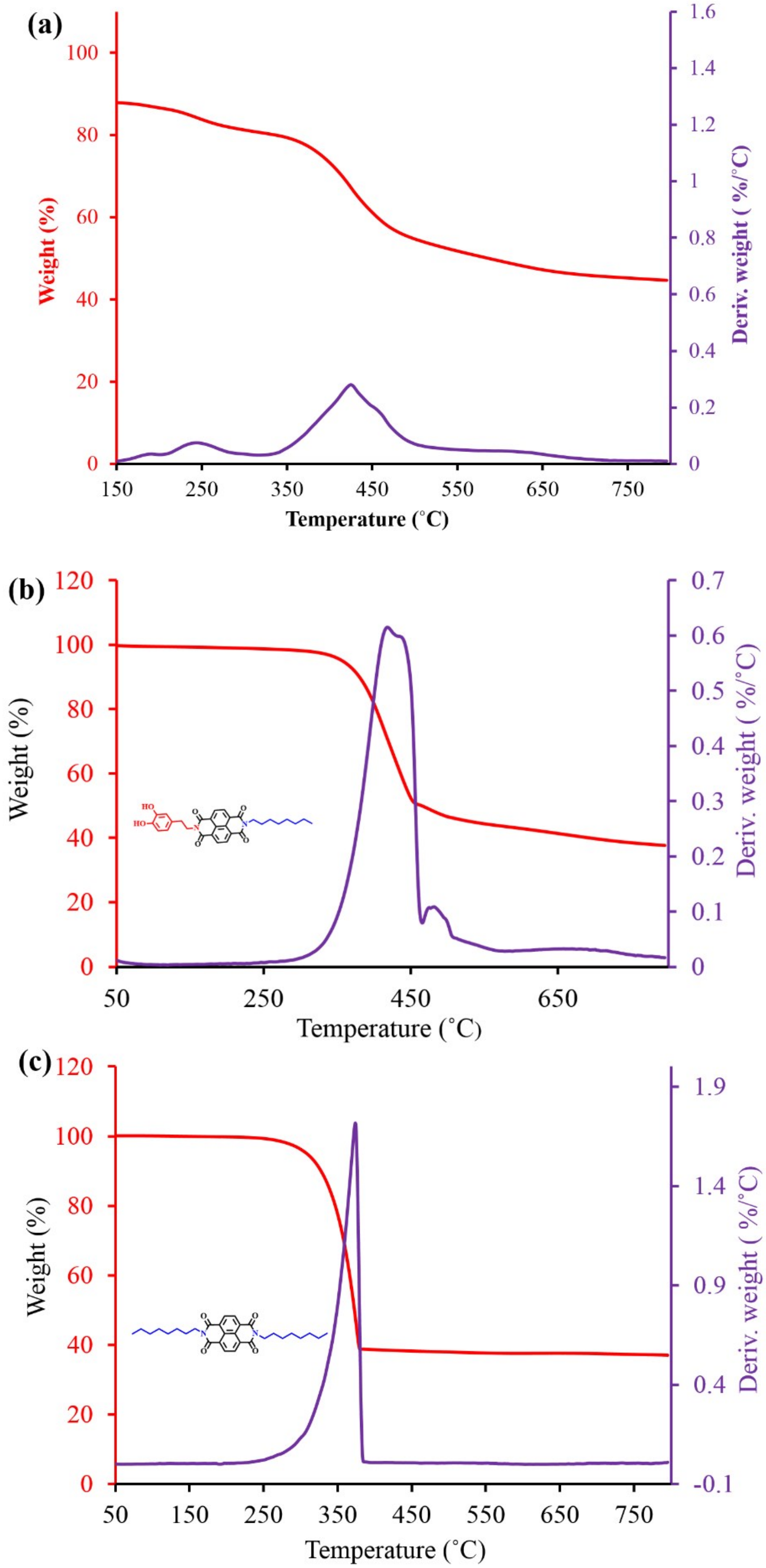


**Fig. S16** Thermogravimetric (TGA) of (a) **NDI-2DP**, (b) **NDI-1DP** and (c) **NDI**.

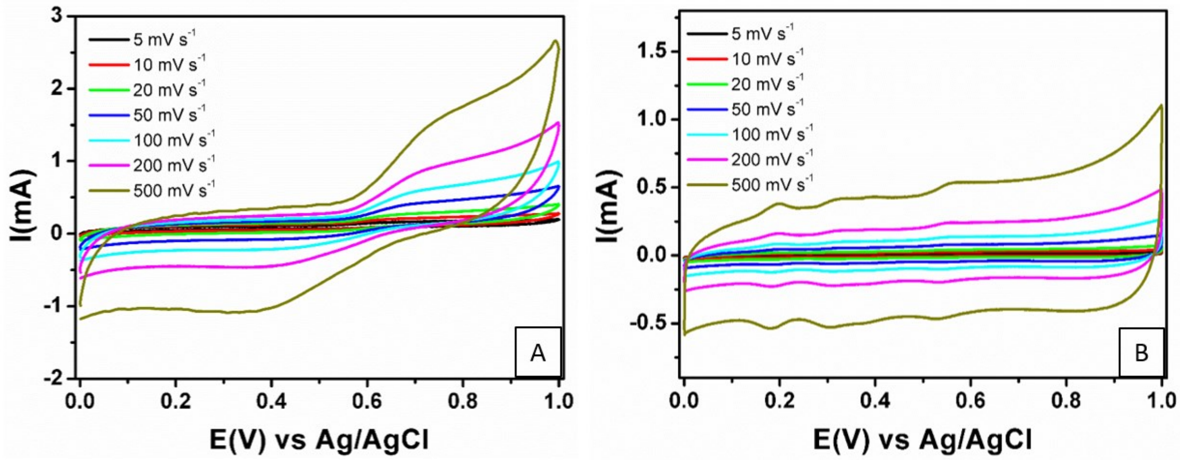


**Fig. S17 Three-electrode system:** Scan rate dependent cyclic voltammograms of (A) **NDI-1DP** and (B) **NDI**.

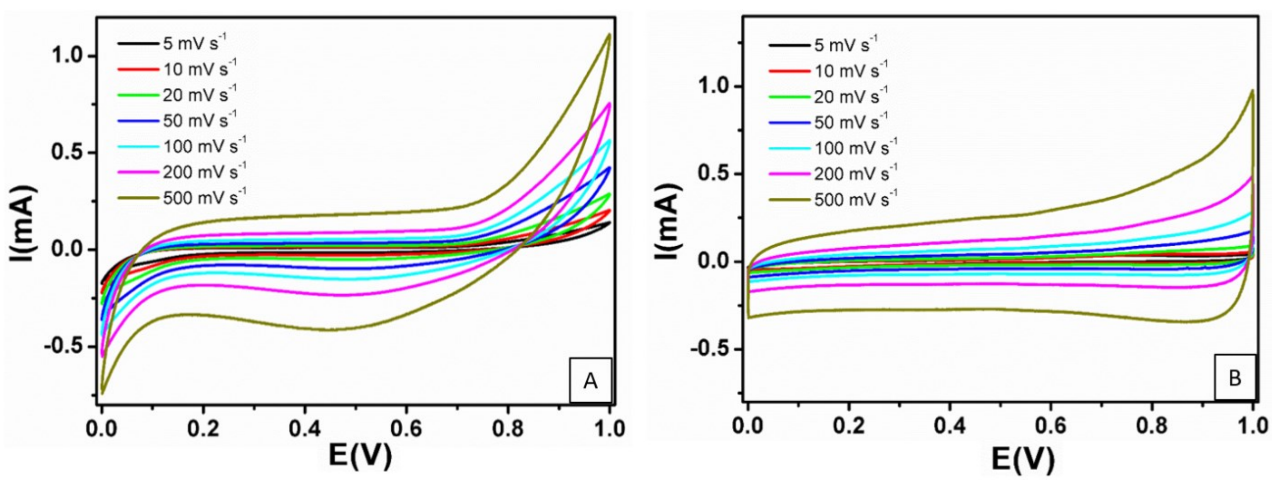


**Fig. S18 Two electrode solid-state symmetric capacitor:** Scan rate dependent cyclic voltammograms of (A) **NDI-1DP** and (B) **NDI**.

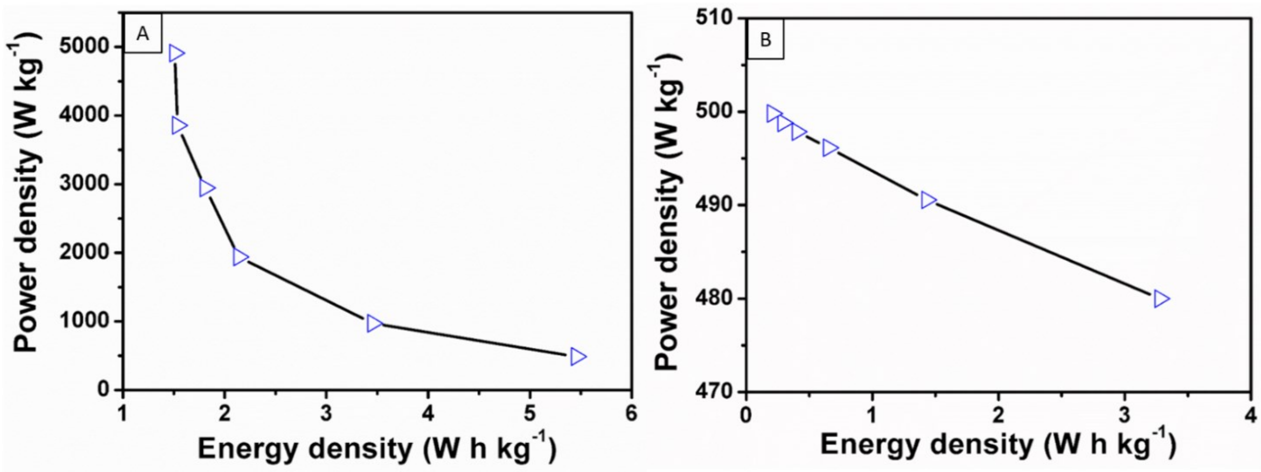


**Fig. S19** Ragone plot for the (A) **NDI-1DP** and (B) **NDI** symmetric cell device.

**Table S1.** Comparison of the electrochemical performances of Naphthalenediimide derivatives with other literature.

| Naphthalene diimide derivatives | Electrolyte | Single electrode-CV | | | CD | | | Cycle No. @ Cs (A g$^{-1}$) retention (%) | Ref No. |
|---|---|---|---|---|---|---|---|---|---|
| | | Voltage (V) | Scan rate (mV s$^{-1}$) | $C_s$ (F g$^{-1}$) | Voltage (V) | Curr. Density (A g$^{-1}$) | $C_s$ (F g$^{-1}$) | | |
| TPA-1Th-NDI | 1 M TEATFB in 1:1 PC and DMC | -2.0 to 0 | 10 | ----- | 0 to 2 | 0.1 mA | 22 | 500 at 0.1 mA >90% | 1 |
| (NIBDZ) | 1 M $H_3PO_4$ | 0 to 1 | 100 | ----- | 0 to 1 | 0.5 | 66.56 | *** | 2 |
| P2 P(NDI2OD-OThCNPV) | 0.5 M $H_2SO_4$ | -0.7 to 0.5 | 10 | ----- | -0.7 to 0.5 | 0.5 | 124 | 5000 at 0.5 100% | 3 |
| P1 P(NDI2OD-OThPV) | 0.5 M $H_2SO_4$ | -0.7 to 0.5 | 10 | ----- | -0.7 to 0.5 | 0.5 | 84 | ----- | 3 |
| P(NDI2OD-T2) | 0.5 M $H_2SO_4$ | -0.7 to 0.5 | 10 | ----- | -0.7 to 0.5 | [a]0.5 | 61 | ----- | 3 |
| P(NDI-Alt-BDT) | 1 M PC-$LiClO_4$ | -0.2 to 1.1 | 10 | ----- | -1.0 to 1 | [b]0.5 | 80 | ------ | 4 |
| P(NDI-r-BDT) | 1 M PC-$LiClO_4$ | -2.0 to 2.0 | 5 | ----- | -1.0 to 1.0 | 0.5 | 44 | ------ | 4 |
| NDI-2DP/CP | 1 M $H_2SO_4$ | 0 – 1.0 | 5 | 202.5 | 0 to 1 | 0.5 | 195.9 | 10000 at 3 mA cm$^{-2}$ *96 %* | This work |

Tetraethylammonium tetrafluoroborate (TEATFB),
Propylene carbonate (PC)
Dimethylcarbonate (DMC)

**References**

1 D.F.Zeigler, S.L.Candelaria, K.A.Mazzio, T.R.Martin, E.Uchaker, S.Suraru, L.J.Kang, G.Cao and C.K.Luscombe, *Macromolecules*, 2015, **15**, 5196-5203.

2 A. Roy, S. Mondal, A. Halder, A. Banerjee, D. Ghoshal, A. Paul and S. Malik, *Eur. Poly. J.,* 2017, **93**, 448-457.

3 S. Sharma, R. Soni, S. Kurugot and S. K. Asha, *Macromolecules*, 2018, **51**, 954–965.

4 S. Sharma, R. Soni, S. Kurugot and S. K. Asha, *J. Phys. Chem. C,* 2019, **123**, 2084−2093.