Supporting Information

Rapid Upcycling of Waste Polyethylene Terephthalate (PET) to Energy Storing Disodium Terephthalate Flowers with DFT Calculations

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Section S1. Theoretical capacity calculation for Na$_2$Tp-SP Composite.

Specific capacities ($1^{st}$ charge capacity) of Super P for different alkali ion are as follows (as shown in figure 4b, c)-

1. Super P // Li - 235 mAh g$^{-1}$.
2. Super P // Na - 120 mAh g$^{-1}$.

Theoretical capacity of Na$_2$Tp-Super P hybrid electrode- Slurry composition (Na$_2$Tp: Super P: PVDF = 5:4:1)

1. Mass fraction of Na$_2$Tp in the hybrid = $5/9 = 0.55$ or 55 %.
2. Mass fraction of Super P in the hybrid = $4/9 = 0.45$ or 45 %.

**Theoretical capacity of Na$_2$Tp- 255 mAh g$^{-1}$ (considering 2e$^-$ transfer)**

Theoretical capacities of Na$_2$Tp- Super P electrode for different alkali ion are as follows-

1. **LIB**- $0.55 \times (255 \text{ mAh g}^{-1}) + 0.45 \times (235 \text{ mAh g}^{-1}) = 140.25 + 105.75 = 246 \text{ mAh g}^{-1}$.
2. **NIB**- $0.55 \times (255 \text{ mAh g}^{-1}) + 0.45 \times (120 \text{ mAh g}^{-1}) = 140.25 + 54 = 194 \text{ mAh g}^{-1}$.
Section S2. $^1$H- and $^{13}$C NMR of Na$_2$Tp and Na$_2$Tp-SP composite anode

Figure S1. $^1$H-NMR spectra of as synthesised Na$_2$Tp

Figure S2. $^{13}$C-NMR spectra of as synthesised Na$_2$Tp.
**Figure S3**. $^1$H-NMR spectra of the Na$_2$Tp-SP composite anode after ball milling.

**Figure S4**. $^{13}$C-NMR spectra of Na$_2$Tp-SP composite anode after ball milling.
Section S3. TGA curve of PET waste.

Figure S5- TGA curve of waste PET flakes under atmospheric condition.