Supporting Information

V_2O_5/Conductive Polymer Nanocables with Build-in Local Electric Field Derived from Interface Oxygen Vacancies for High Energy Density Supercapacitors

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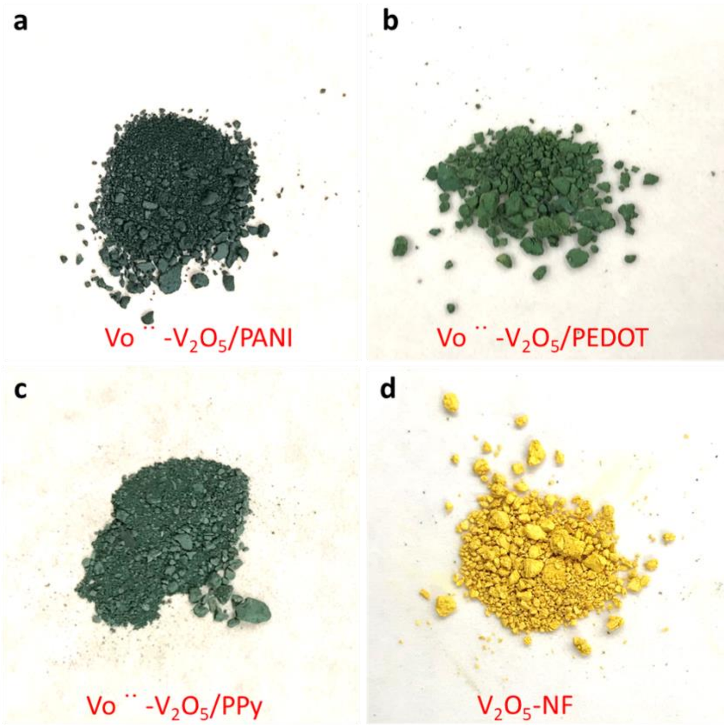

Figure S1.The digital images of Vo¨-V_2O_5/CP nanocables and V_2O_5-NF.

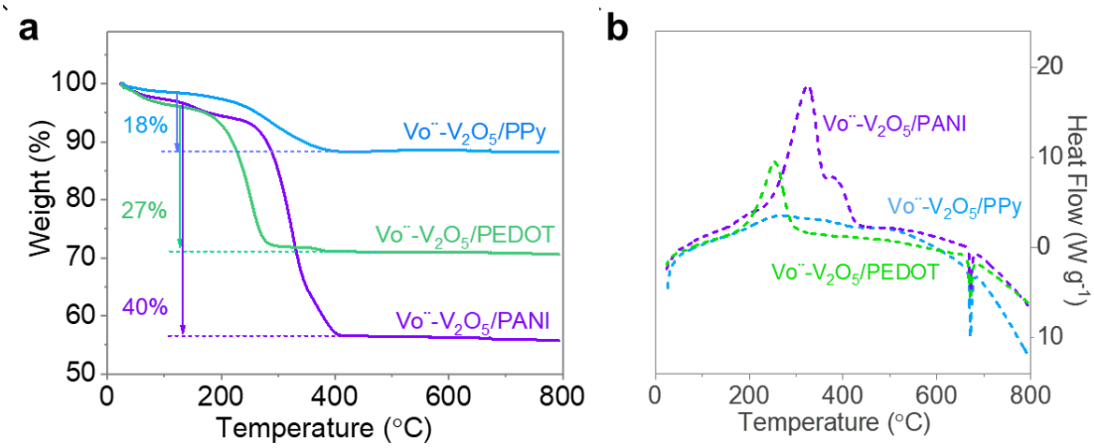

Figure S2. The TG-DSC curves of all Vo¨-V_2O_5/CP nanocables.

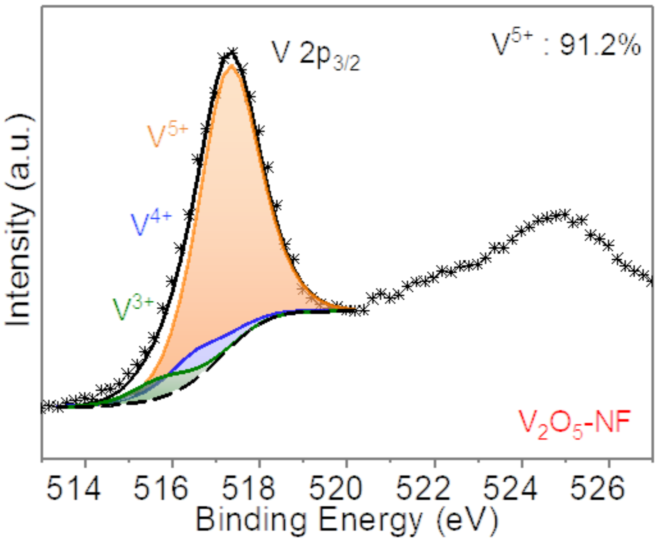

Figure S3. The XPS spectrum and corresponding decompositions of V $2p_{3/2}$ peak of V_2O_5-NF.

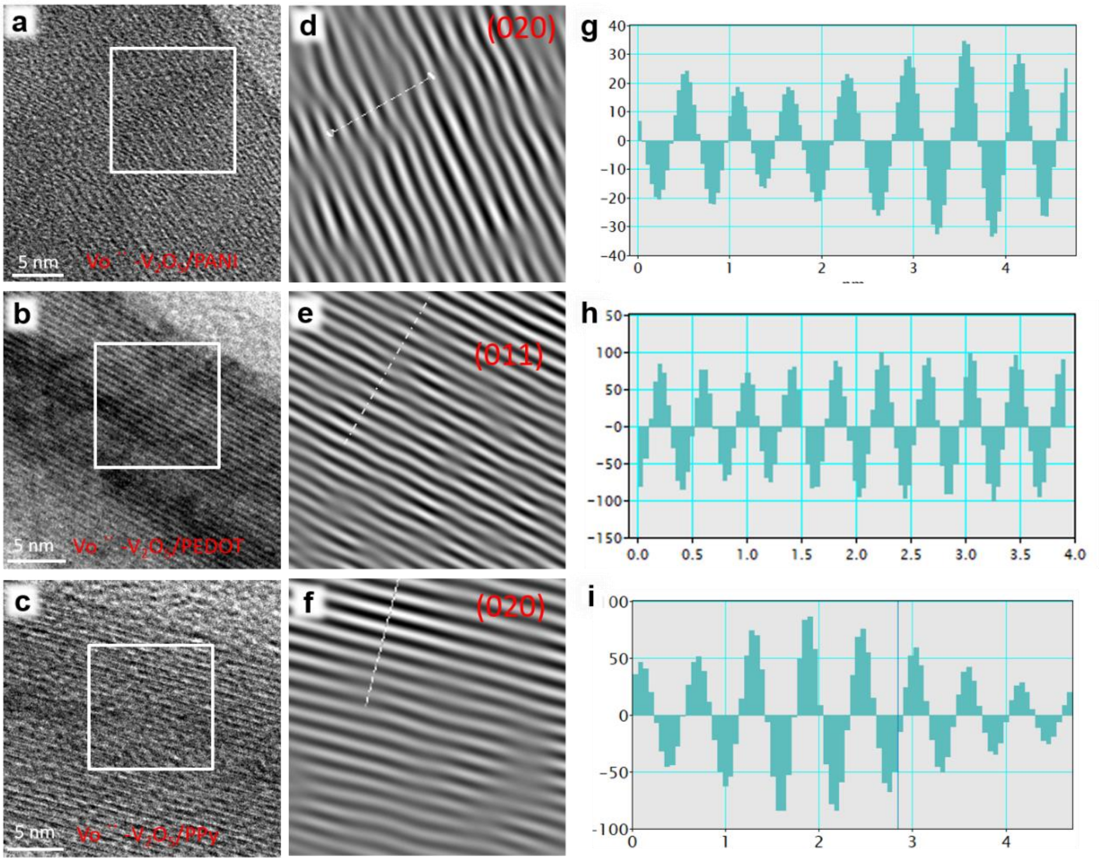

Figure S4. (a, b, c) HRTEM images of Vo¨-V_2O_5/PANI, Vo¨-V_2O_5/PEDOT and Vo¨-V_2O_5/PPy. (d, e, f) IFFT patterns of selected areas in HRTEM. The Vo¨-caused dislocations can be easily observed. (e, f) Linear profiles obtained from the white lines in corresponding IFFT images, respectively. The interlayer spaces are expended due to Vo¨.

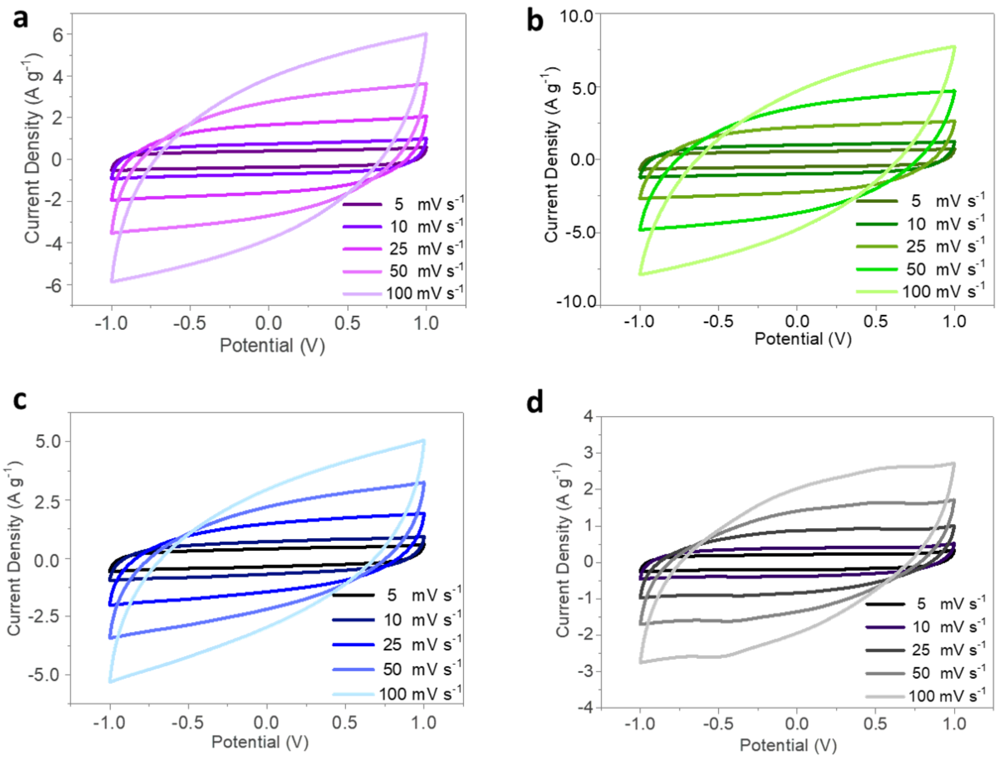

Figure S5. The CV curves of Vo¨-V_2O_5/PANI, Vo¨-V_2O_5/PEDOT, Vo¨-V_2O_5/PPy and V_2O_5-NF.

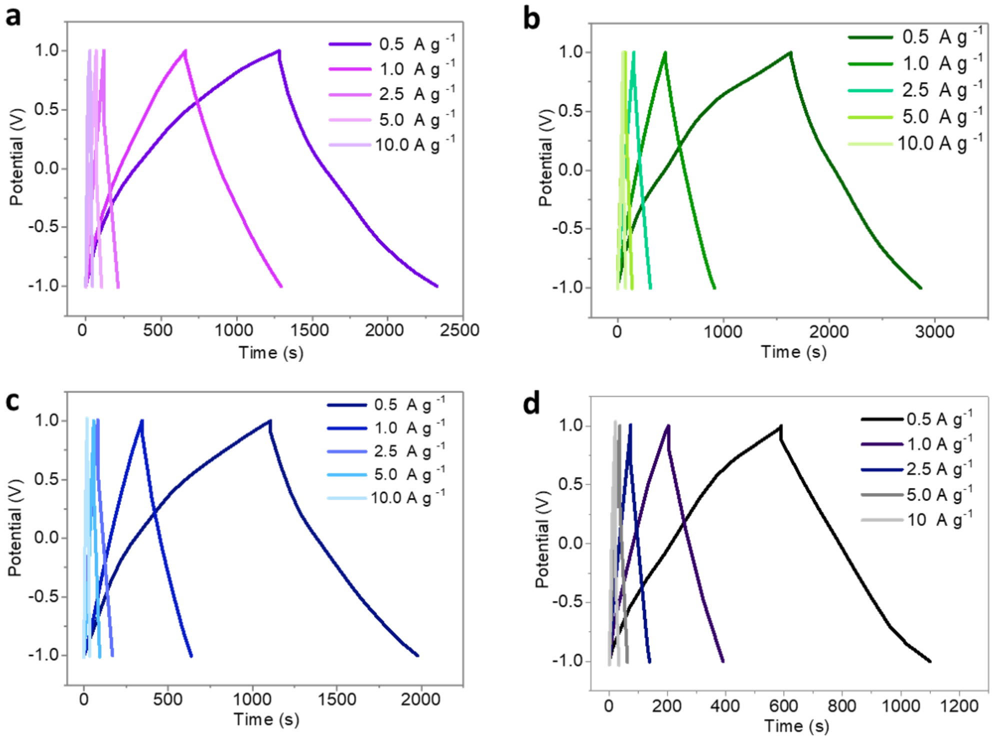

Figure S6. The GCD curves of (a) Vo¨-V_2O_5/PANI, (b) Vo¨-V_2O_5/PEDOT, (c) Vo¨-V_2O_5/PPy and (d) V_2O_5-NF.

	$Vo^{\cdot\cdot}$-V_2O_5/PEDOT	$Vo^{\cdot\cdot}$-V_2O_5/PANI	$Vo^{\cdot\cdot}$-V_2O_5/PPy	V_2O_5-NF
R*s* (Ω)	0.5	0.6	0.5	0.7
R*ct* (Ω)	2.3	3.0	5.9	8.4
σ_w	14.45	11.21	10.11	7.45
D_{Na+} (10^{-12} cm^2/s)	9.54	5.17	4.12	2.51

Table S1. The R*s,* R*ct*, σ_w and D_{Na+} values of $Vo^{\cdot\cdot}$-V_2O_5/PANI, $Vo^{\cdot\cdot}$-V_2O_5/PEDOT, $Vo^{\cdot\cdot}$-V_2O_5/PPy and V_2O_5-NF, which are obtained by ZsimpWin from EIS curves.

The Na^+ ion diffusion coefficient of the electrode materials is calculated from the low frequency regions of corresponding EIS plots based on the following equation.

$$D_{Na^+} = \frac{R^2\, T^2}{2\, A^2\, n^4\, F^4\, C^2\, {\sigma_w}^2}$$

F is 96500 $C\cdot mol^{-1}$) is the Faraday constant;

R (8.314 $J\cdot mol^{-1}\cdot K^{-1}$) is gas constant;

T(298 K) is the absolute temperature;

A (cm^2) is the surface area of the electrode;

C ($mol\cdot cm^{-3}$) is concentration of Na^+ ion in the electrolyte;

n is the number of electrons transferred per molecule;

σ_w is Warburg coefficient which is obtained by ZsimpWin software.

	$Vo^{\cdot\cdot}$-V_2O_5/PEDOT	$Vo^{\cdot\cdot}$-V_2O_5/PANI	$Vo^{\cdot\cdot}$-V_2O_5/PPy
σ (S/cm)	300-500	0.1-5	10-50
Coating thickness (nm)	5.0	6.7	3.5
R (Ω/nm)	17~28	1239~61941	247~1237

Table S2. The estimated *R* values of $Vo^{\cdot\cdot}$-V_2O_5/CPs.

In $R = L/\sigma A$, A is cross sectional area of CP in a nanocable, σ is the Electrical conductivity and *L* is the length (nm). Here, the average diameter is estimated to be 35 nm according to the SEM and TEM images.

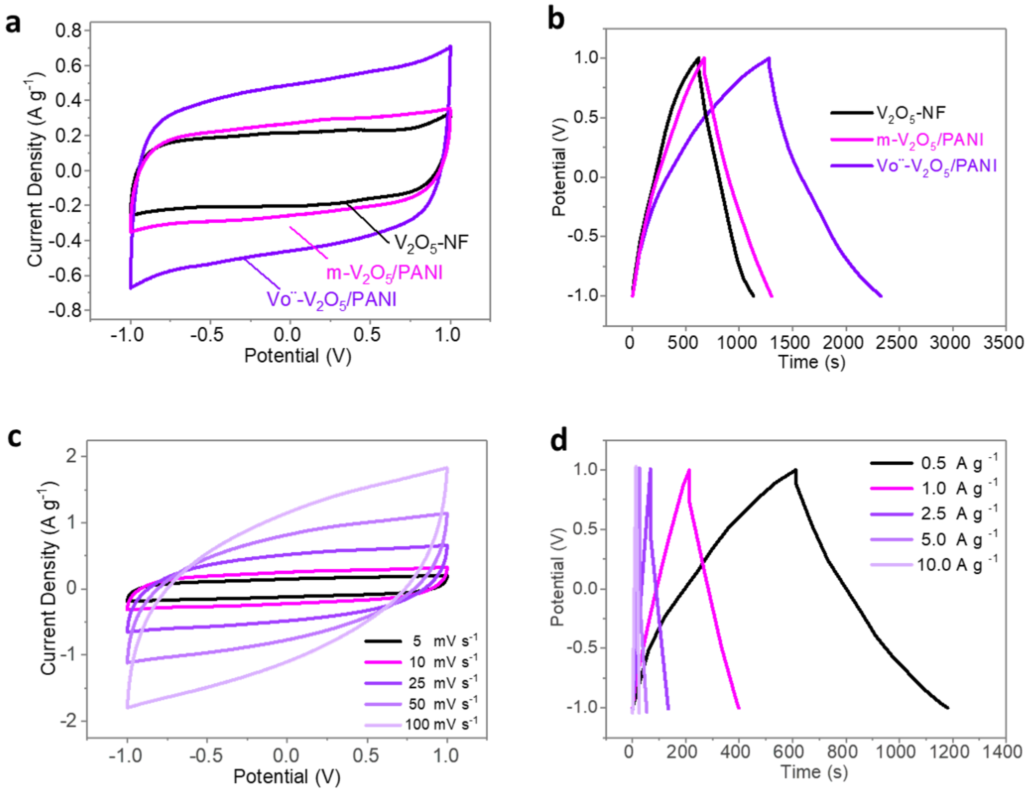

Figure S7. (a) The CV curves of Vo¨-V_2O_5/PANI, m-V_2O_5/PANI and V_2O_5-NF at 5mV s^{-1}. (a) The GCD curves of Vo¨-V_2O_5/PANI, m-V_2O_5/PANI and V_2O_5-NF at 0.5 A g^{-1}. (c) The CV curves of m-V_2O_5/PANI at different scan rates. (d) The GCD curves of m-V_2O_5/PANI at different current densities.

Considering the CPs have similar function in our samples, and commercial PANI has the lowest price than PEDOT and PPy, which can be found on Sigma-Alorich company website, the synergistic effects of Vo¨ and CPs are explored by taking Vo¨-V_2O_5/PANI for example. V_2O_5-NF and commercial PANI are mechanically mixed with the mass ratio from the TG results, noted as m-V_2O_5/PANI. All the electrochemical measurements are conducted under the same conditions. As shown above, the m-V_2O_5/PANI electrode shows a specific capacitance of 280 F g^{-1} at 0.5 A g^{-1}, which is smaller than that of Vo¨-V_2O_5/PANI (523 F g^{-1}), larger than that of V_2O_5-NF (225 F g^{-1}). Thus, the excellent electrochemical performance of Vo¨-V_2O_5/CPs is attributed to the synergistic effects of Vo¨ and CPs.

References