Supplementary information

$TiNb_2O_7$/Graphene Composites as a High-Rate Anode Material for Lithium/Sodium Ion Batteries

Shuang Li,[ab] Xi Cao,[b] Charles N Schmidt,[b] Qian Xu,[a] Evan Uchaker,[b] Yi Pei,[b] Guozhong Cao*[b]

[a]*School of Materials Science and Metallurgy, Northeastern University, Shenyang 110819, PR China*

[b]*Department of Materials Science and Engineering, University of Washington, Seattle, Washington 98195, United States. E-mail: gzcao@u.washington.edu. Tel.: +1-206-616-9084. Fax: +1-206-543-3100.*

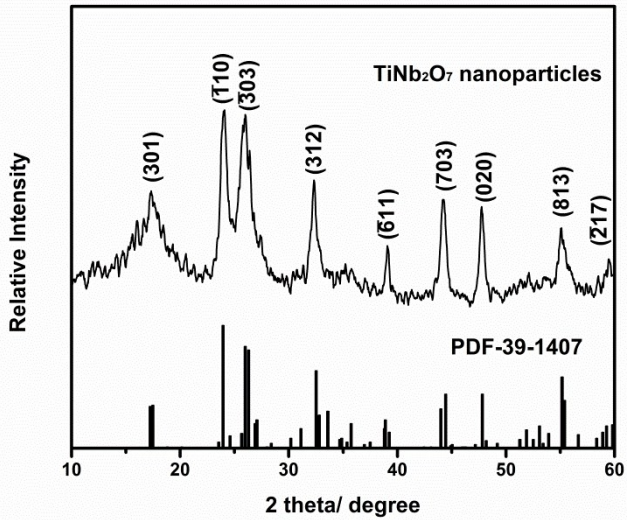

Figure S1. XRD patterns of pure TNO before freeze drying and thermal reduction. The vertical lines at the bottom correspond to the standard XRD reflections of monoclinic $TiNb_2O_7$.

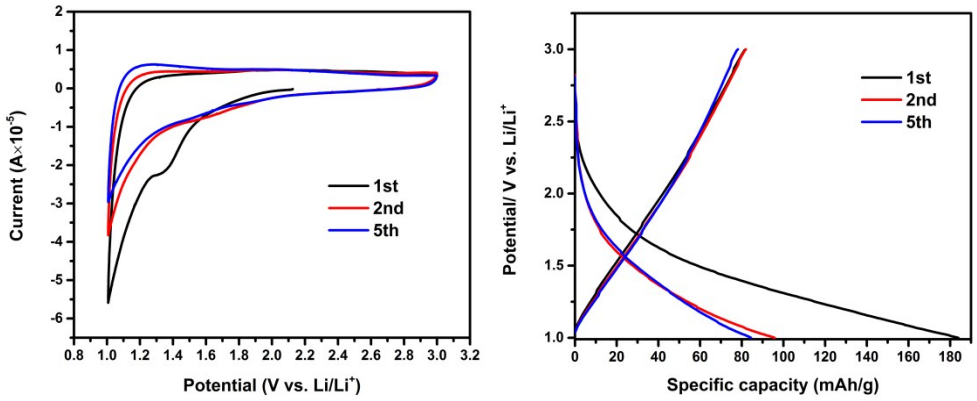

Figure S2. (a) CV curves of pure graphene electrodes at 0.2 mV s^{-1} in lithium coin cells; (b) discharge-charge profiles of pure graphene electrodes in lithium coin cells at current rate of 0.1 C.

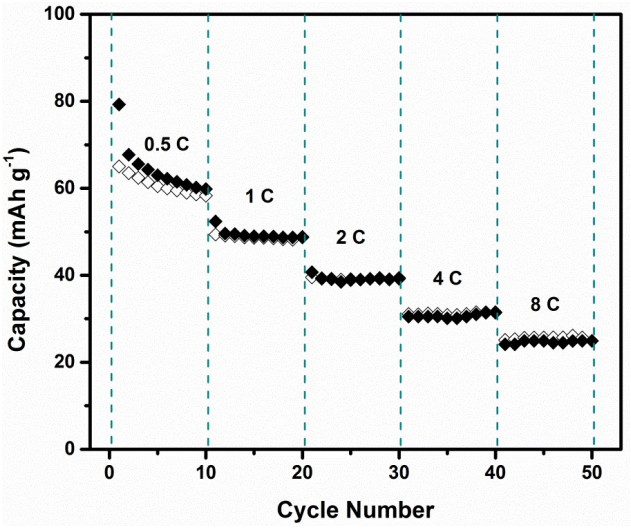

Figure S3. Rate capacities of pure graphene sheets synthesized in this work

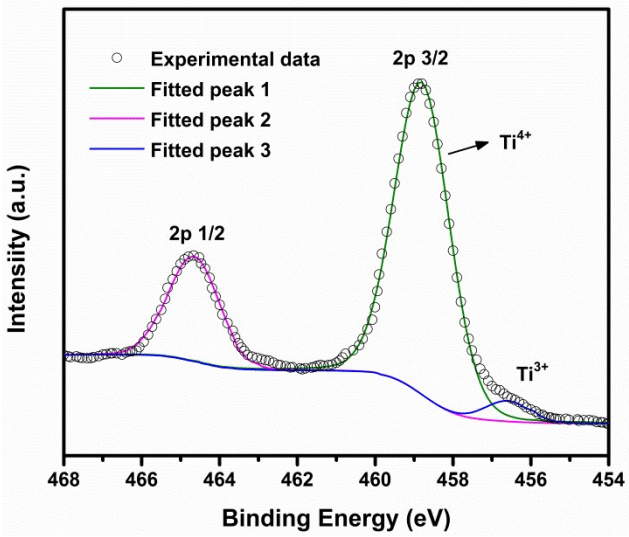

Figure S4. Ti2p XPS spectra of TNO/G composite after annealed in Ar with Ti^{3+} available.

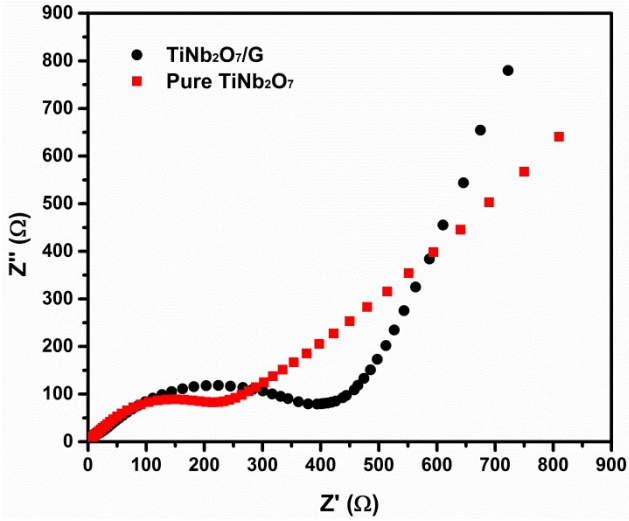

Figure S5. Nyquist plots of EIS results of TNO/G and pure TNO electrodes after 5 discharge and charge cycles.

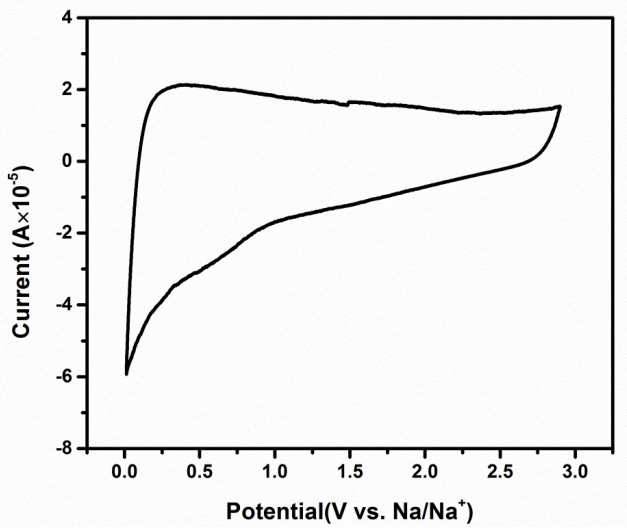

Figure S6. The 100th cycle CV curve of TNO/G composite at 0.2 mV s^{-1}.

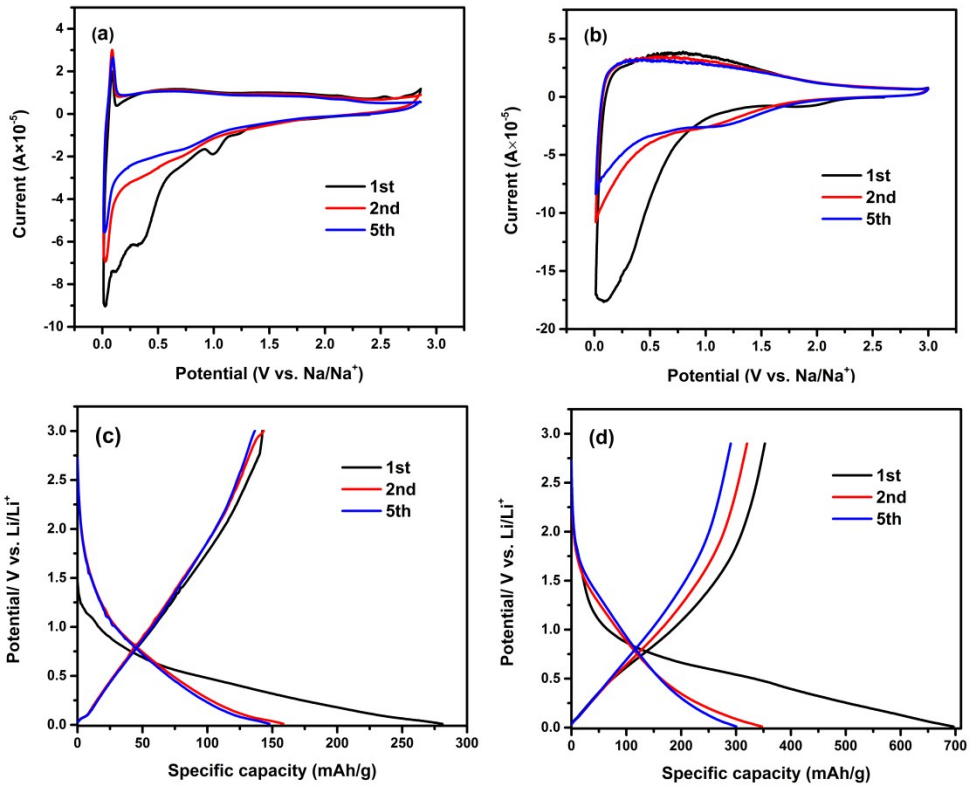

Figure S7. CV curves of (a) pure TNO and (b) pure graphene electrodes at 0.2 mV s^{-1}; discharge-charge profiles of (c) pure TNO and (d) pure graphene electrodes in sodium coin cells at current density of 25 mA g^{-1}.

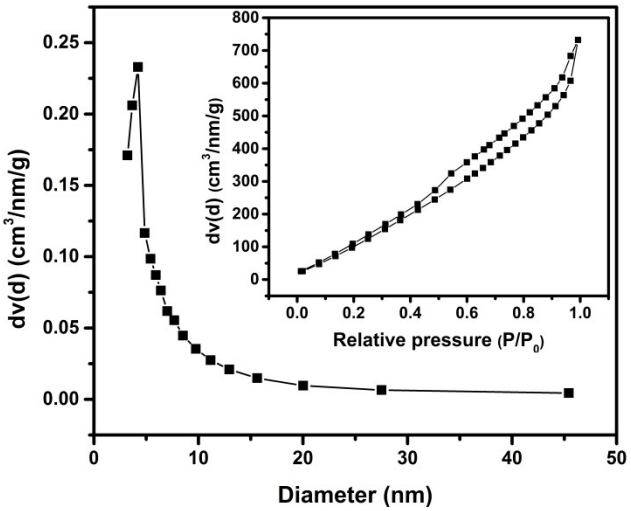

Figure S8. BJH desorption pore size distribution for the as synthesized graphene sheets (inset: N_2 adsorption-desorption isotherm).

Table S1. Specific capacity values of pure TNO (C^{TNO}), graphene (C^{G}) and enhanced capacities ($C^{TNO/G}_{exp} - C^{TNO/G}_{cal}$) from Figure 6.

Capacity Values (mA h g^{-1})	Discharge-Charge Rate (1C=387 mA g^{-1})				
	0.5 C	1 C	2 C	4 C	8 C
C^{TNO}	136.5	108.7	81.2	54.9	33.4
C^{G}	24.3	19.5	15.7	12.5	10.2
$C^{TNO/G}_{cal}$	160.8	128.2	96.9	67.4	43.6
$C^{TNO/G}_{exp}$	201.2	186.1	170.6	154.3	133.9
$C^{TNO/G}_{exp} - C^{TNO/G}_{cal}$	40.4	57.9	73.7	86.9	90.3