Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Core-Shell Anatase Anode Materials for Sodium-Ion Batteries: the Impact of Oxygen Vacancies and Nitrogen-doped Carbon Coating

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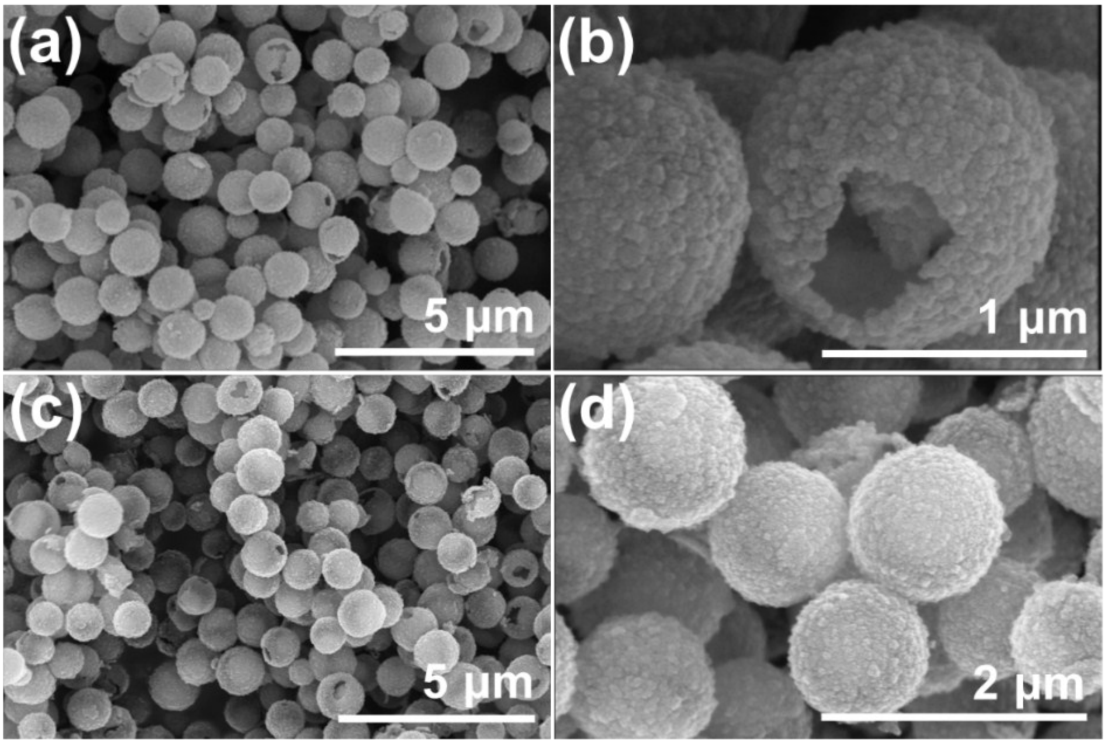

Fig. S1 SEM images of core-shell TiO_2 (a, b) and (c, d) TiO_{2-x}.

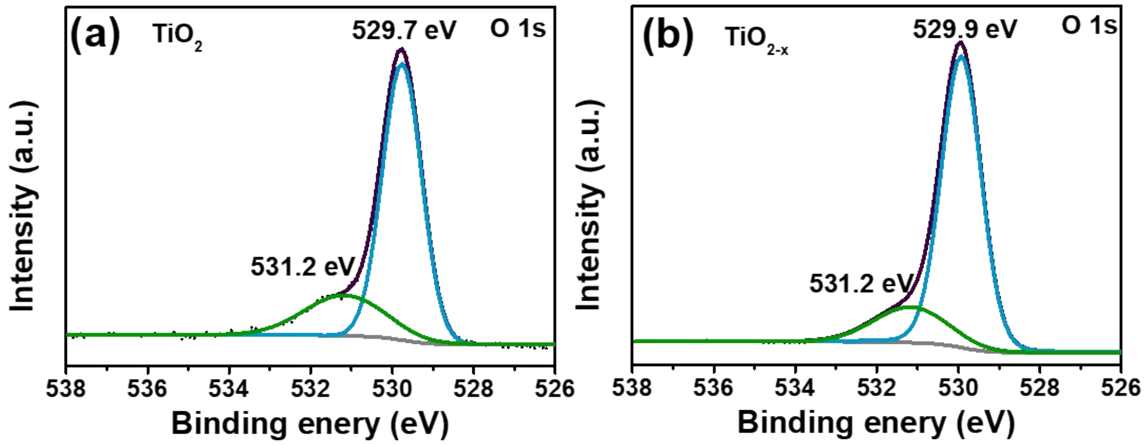

Fig. S2 High-resolution Ti 2p and O 1s spectra of TiO_2 and TiO_{2-x}

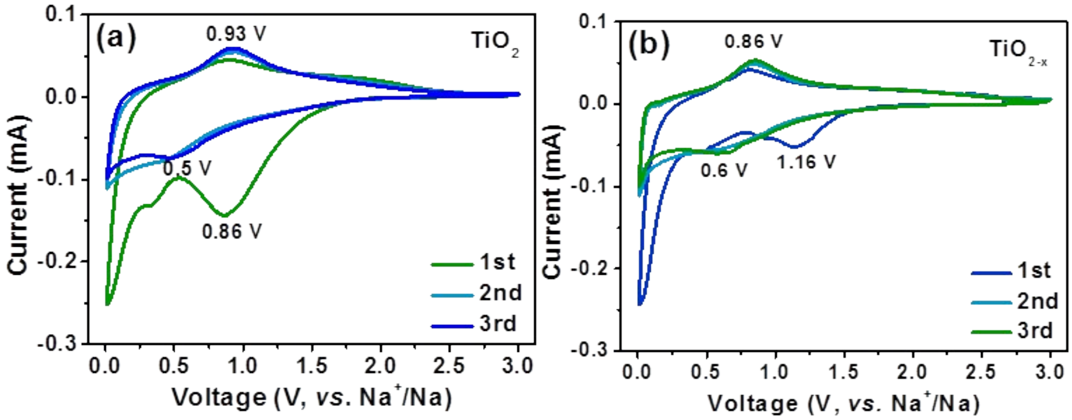

Fig. S3 CV curves of TiO_2 (a) and TiO_{2-x} (b) at a scan rate of 0.1 mV s^{-1}.

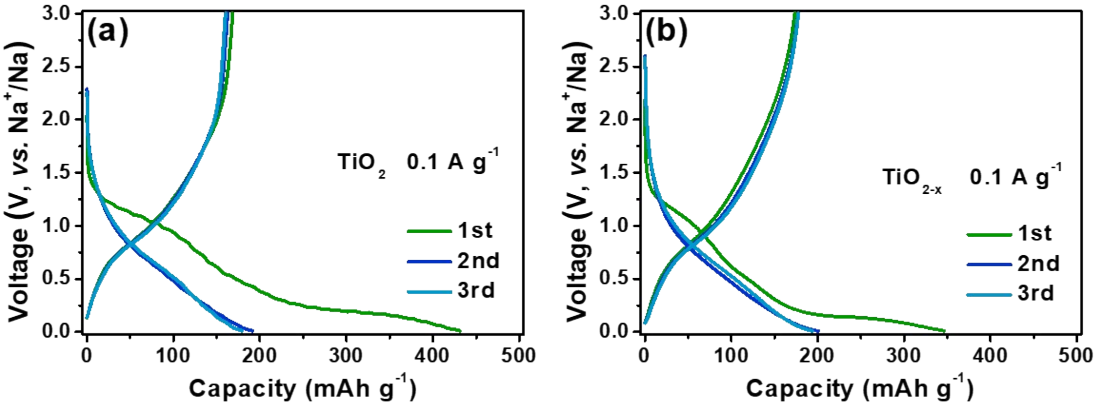

Fig. S4 (a) galvanostatic charge/discharge profiles at a current density of 0.1 A g^{-1} of (a) TiO_2 and (b) TiO_{2-x}. The corresponding ICE are 39.1% and 50.1%, respectively.

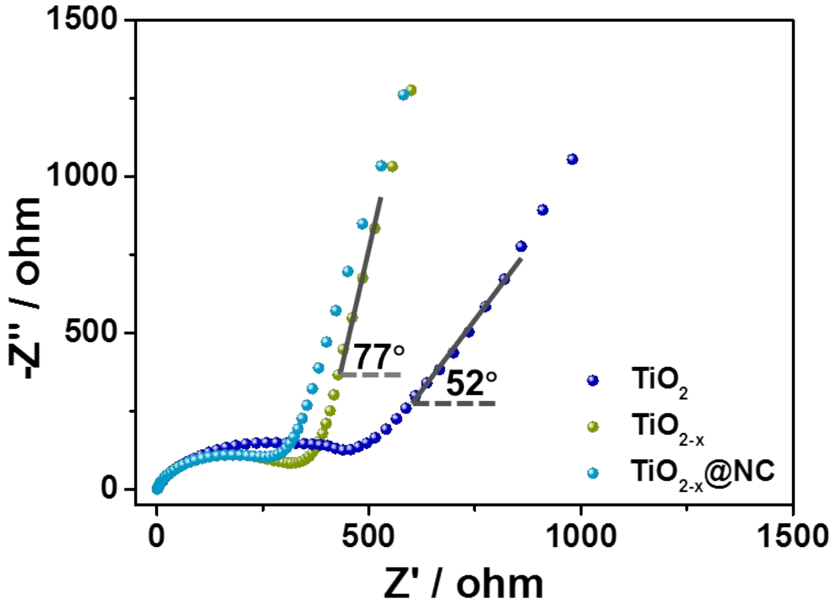

Fig. S5 Nyquist plots of the core-shell TiO_2, TiO_{2-x}, and TiO_{2-x}@NC electrodes before cycling in the frequency range from 0.01 Hz to 100 kHz.

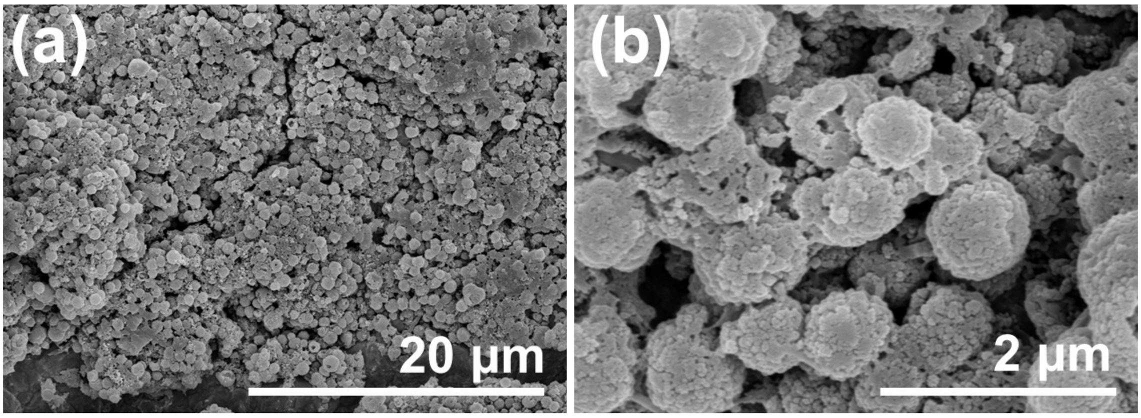

Fig. S6 SEM images of the TiO_{2-x}@NC electrode after charge/discharge process at 0.1A g^{-1} for 200 cycles.

Table S1 Comparison of the electrochemical performance of the Core-shell TiO_{2-x}@NC with TiO_2-based anode materials for SIBs reported previously.

Material	Current density (A g^{-1})	ICE	Capacity/cycles Capacity retention (vs. the 2^{nd} cycle)	Rate capacity (mAh g^{-1})	Current density (A g^{-1})	Ref.
Core-shell TiO_{2-x}@NC	**0.1**	**57.7%**	**245.5/200th 96.5%**	**264.4, 245.3, 226.4, 206.3, 177.8, 155.6**	**0.1, 0.2, 0.5, 1.0, 2.0, 5.0**	**This work**
yolk@shell TiO_{2-x}	0.05	58.8%	230.7/200th 120%	221.6, 200.5, 181.1, 147.1, 121.5, 95.8, 68.6	0.05, 0.1, 0.2, 0.5, 1, 2, 5	Ref. 1
TiO_2(A/B)-MS	0.25	--	~175/1000th 100%	215, 200, 185, 180, 155, 140, 120, 90, 75, 45	0.025, 0.05, 0.125, 0.25, 0.75, 1.25, 2.5, 5, 7.5, 12.5	Ref. 2
TiO_2∩NCSN flowers	0.167	36.7%	36/800th 100%	201, 171, 157, 149, 133, 119, 100	0.084, 0.167, 0.335, 0.67, 1.67, 3.35, 6.7	Ref. 3
TiO_2@CMK-3	0.05	45.8%	186.3/100th 124.5/500th	220.7, 182.4, 157.4, 139.8, 128.8, 105.9	0.05, 0.1, 0.2, 0.4, 0.8, 1.6	Ref. 4
$STiO_2$@SC	0.2	46%	212.9/200th	230, 170, 140, 130, 115	0.2, 0.4, 0.6, 0.8, 1.0	Ref. 5
TiO_2@RGO	0.05	60.7%	206.9/200th 74.0%	248.5, 204.2, 167.3, 151.3, 118.8	0.05, 0.1, 0.5, 1.0, 2.0	Ref. 6
R-TiO_{2-x}-S	0.05	42.7%	254.2/100th 101.7%	264.8, 243.7, 222.5, 183.8, 162.9, 138.3	0.05, 0.1, 0.2, 0.5, 1, 2	Ref. 7

TiO_2@NFG hybrid nanosheets	0.167	49%	185/800th	205, 190, 170, 157, 140, 129, 120, 116, 110	0.084, 0.167, 0.335, 0.670, 1.675, 3.35, 6.70, 10.05, 13.4	Ref. 8
TiO_2/SA	0.0335	62%	205/100th 82%	230, 200, 190, 175, 155, 130, 110, 82	0.0335, 0.0670, 0.167, 0.335, 0.670, 1.67, 3.35, 6.70	Ref. 9
TiO_{2-x}/NCFs	0.1	~38.9 %	210/100th ~87.5%	230, 200, 176, 145, 120	0.05, 0.1, 0.2, 0.5, 1	Ref. 10
N-doped C-coated TiO_{2-x}	0.084	52.7%	272/200th ~91.5%	338, 301, 280, 258, 226, 197, 170, 150	33.6, 84, 168, 336, 840, 1680, 3360, 5040	Ref. 11
a-TiO_{2-x}/r-TiO_{2-x}	0.067	40%	210/300th 76.3%	330, 255, 228, 199, 158, 130, 103	0.067, 0.167, 0.335, 0.67, 1.67, 3.35, 6.70	Ref. 12
TiO_2@CNT@C Nanorods	0.5	--	183/350th 98%	230, 200, 159.6, 141.6, 115.5, 85, 71	0.05, 0.2, 1, 2, 4, 8, 12	Ref. 13
NC TiO_2-Y	0.167	58.3%	243.2/200th 116%	253.3, 211.5, 179.1, 162.1, 140.9, 122.2, 115.9	0.167, 0.335, 0.670, 1.67, 3.35, 5.03, 6.70	Ref. 14
defect-rich TiO_{2-d}/C (D-MTO-700)	0.2	57.3%	238.5/600th 91.3%	330.2, 280.5, 249.4, 217.2, 172.2, 128.3, 98.1, 88.6	0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10	Ref. 15
S-TiO_2 nanotube array	0.0335	52%	--	322, 271, 242, 216, 197, 167	0.0335, 0.167, 0.335, 0.670, 1.67, 3.35	Ref. 16
(TiO_2 @rGO	0.066	--	124/300th 87%	170, 151, 128, 108, 90, 70, 55	0.033, 0.066, 0.165, 0.33, 0.66, 0.165, 3.3	Ref. 17

TiO_2@C-600	0.01678	56.4%	190/100th 95%	181, 167, 95, 65	0.01678, 0.03356, 0.3356, 3.356	Ref. 18
TiO_2 microspheres	0.0168	44.1	121.3/200th 83.1%	135.3, 105.2, 72.3, 48.8, 17.7	0.084, 0.168, 0.336, 0.84, 1.68	Ref. 19
TiO_2 hollow spheres	0.02	--	212/200th --	266, 245, 226, 192, 139	0.04, 0.08, 0.16, 0.32, 0.64	Ref. 20
Ni-TiO_2 Nanoarrays	0.05	--	200/100th --	220, 192, 157, 132, 110, 95	0.1, 0.2, 0.5, 1, 2, 5	Ref. 21
TiO_2-F/CNTs	0.025	36.3%	234/100th 97%	210, 118	2.5, 25	Ref. 22

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