Electronic Supplementary Information (ESI)

Nitrogen-doped-carbon-coated SnO_2 nanoparticles derived from SnO_2@MOF composite as lithium ion battery anode material

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Contents of ESI

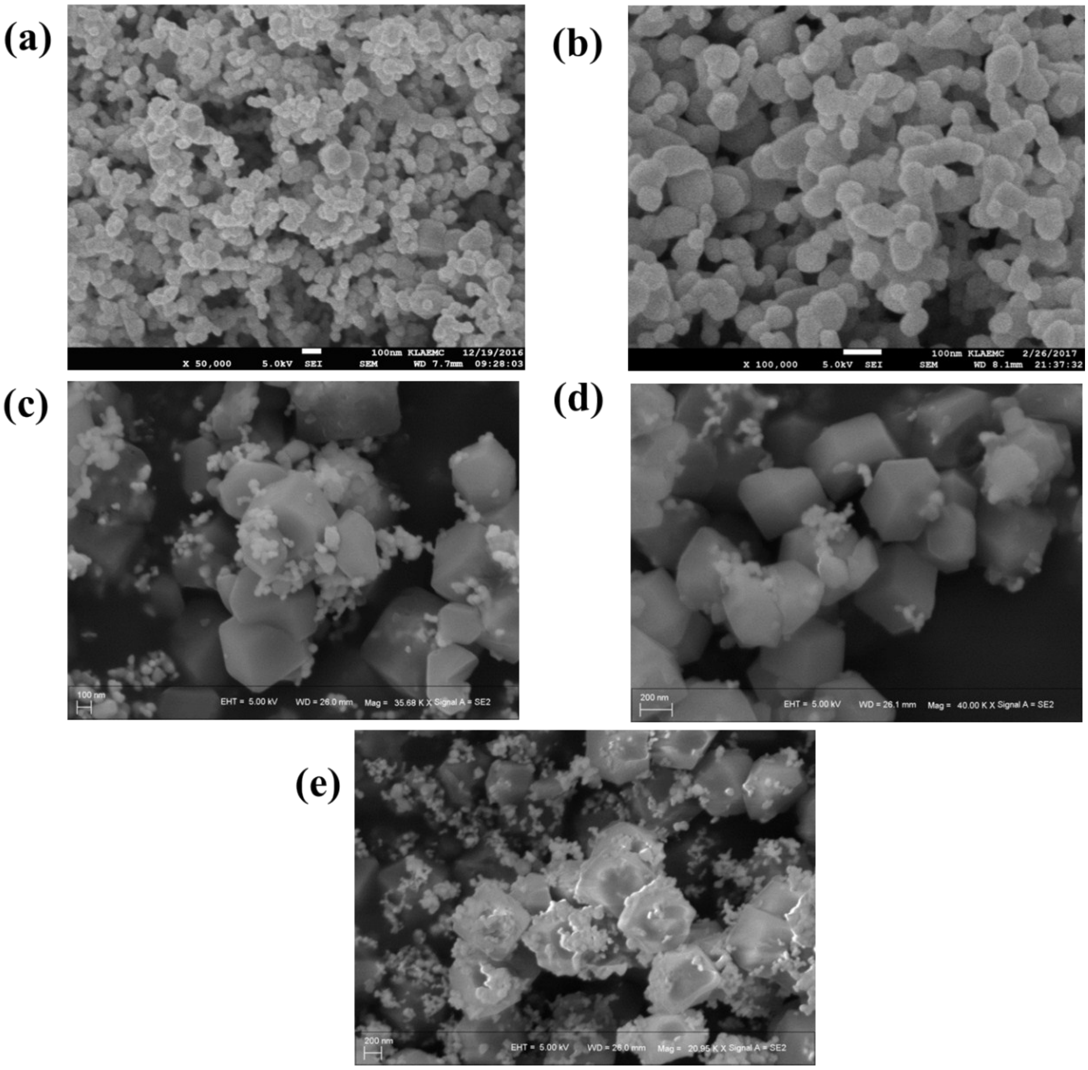

Fig. S1 SEM images of initial SnO_2 nanoparticles (a),calcination product of SnO_2 nanoparticles at 800 °C in Ar atmosphere for 3 h (b), SOZ-1 (c), SOZ-2(d) and SOZ-3 (e). The size of octahedral ZIF-8 nanocrystals is about 200 nm. The size of initial SnO_2 nanoparticles and its calcination products express almost the same size and morphology. The uniform SnO_2 nanoparticles is highly dispersed, and were tightly adhered to the surface of ZIF-8.

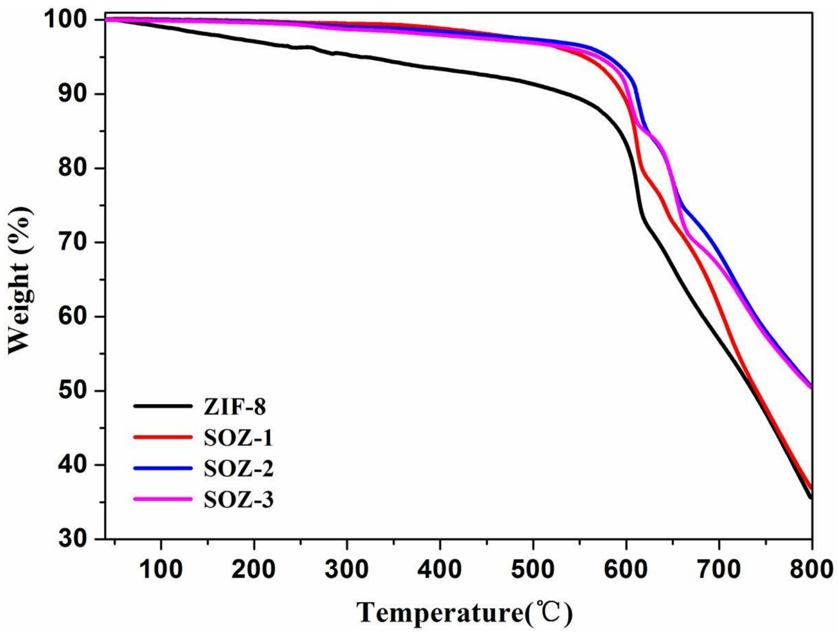

Fig. S2 TGA curves of the precursors.

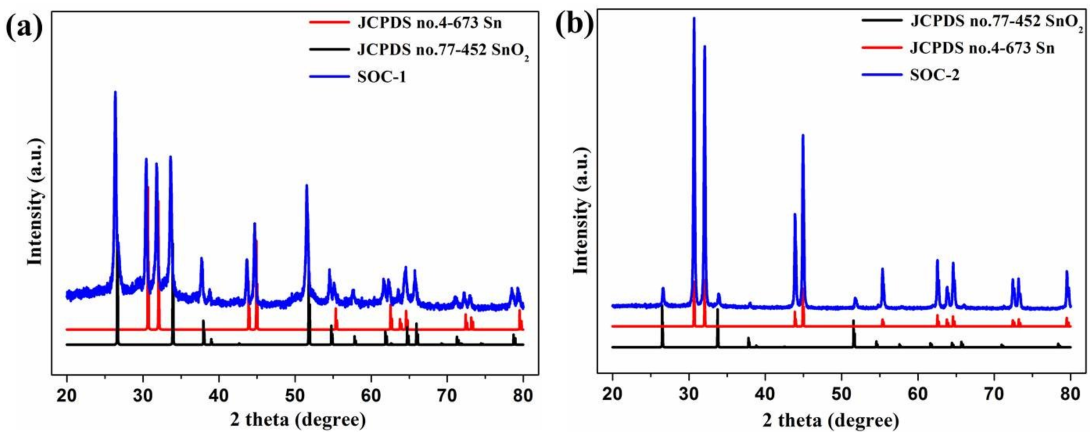

Fig. S3 PXRD of SOC-1 (a) and SOC-2 (b). There are peaks from Sn nanoparticles which are from carbonthermal reduction of SnO_2. All the diffraction peaks could be indexed to the tetragonal Sn nanoparticles (JCPDS no. 4-673) and tetragonal SnO_2 nanoparticles (JCPDS no. 21-1250).

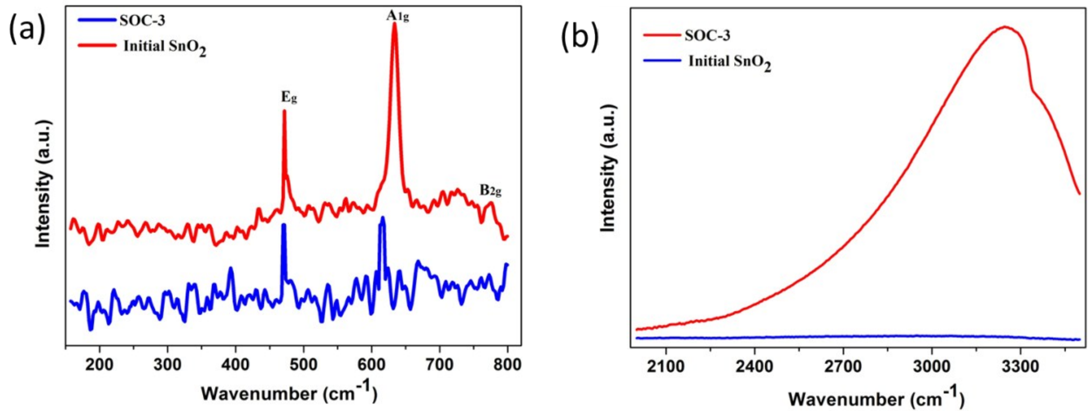

Fig. S4 Raman spectra of SnO_2 in initial status (a) and in SOC-3(b).

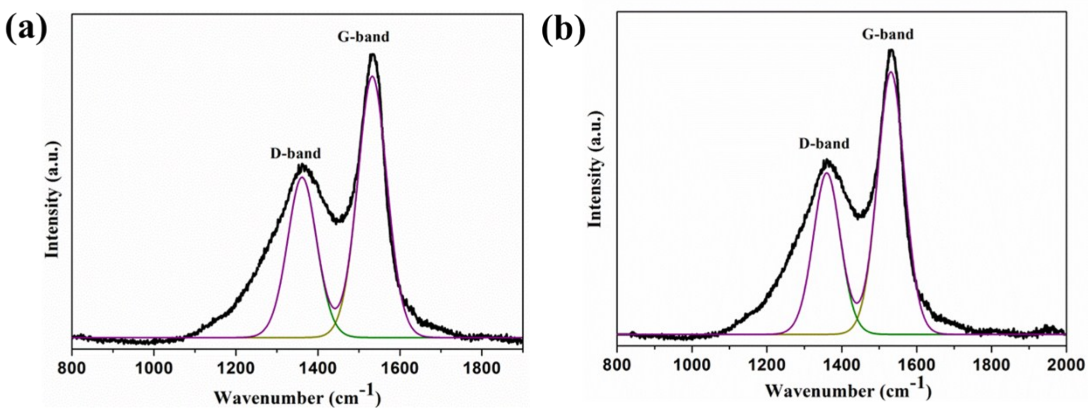

Fig. S5 Raman spectra of SOC-1 (a) and SOC-2 (b).

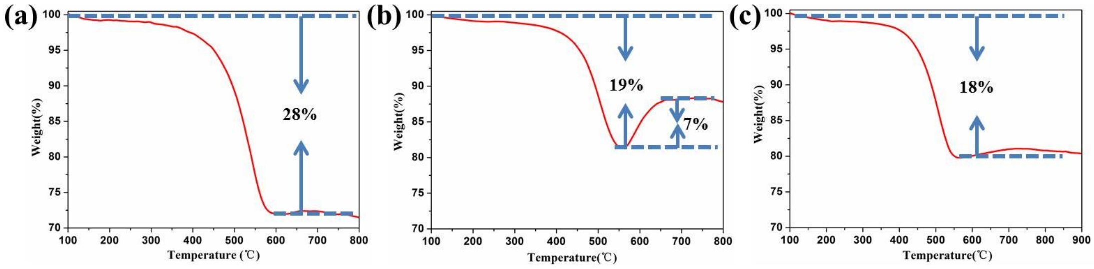

Fig. S6 TGA curves of SOC-1 (a), SOC-2 (b) and SOC-3(c). According to TGA, the carbon contents are 28% for SOC-1, 19% for SOC-2, 18% for SOC-3. The carbon and nitrogen contents of the three materials from TGA are well consistent with elemental analysis results.

(a) (b)

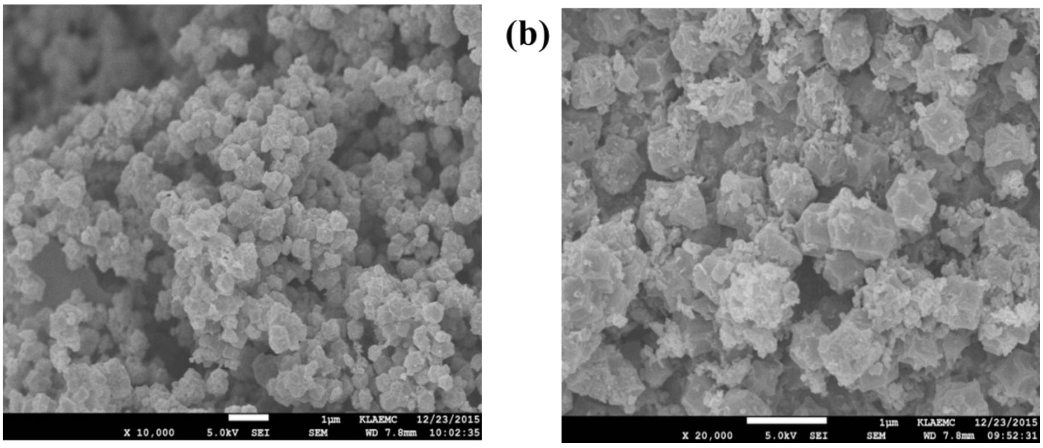

Fig. S7 SEM of SOC-1 (a) and SOC-2 (b).

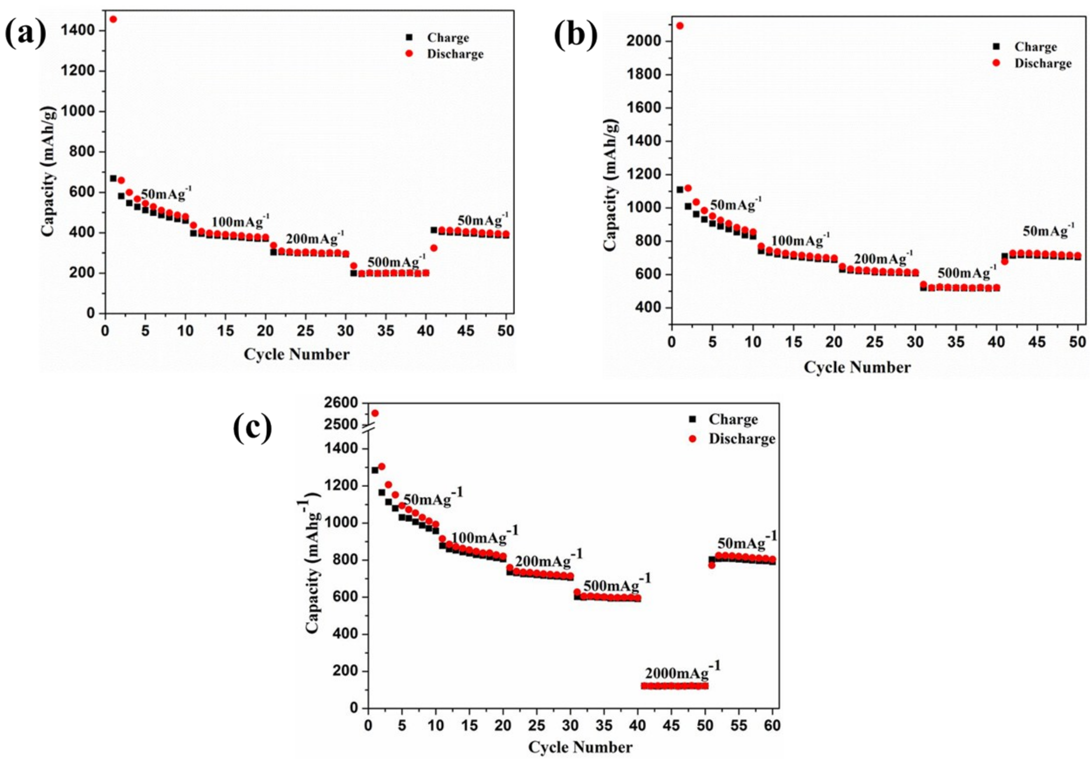

Fig. S8 Rate performances of SOC-3 (a) from 50 to 2000 mA g^{-1}, SOC-1 (a) and SOC-3 (b) electrodes from 50 to 500 mA g^{-1} and SOC-3 (c) from 50 to 2000 mA g^{-1}.

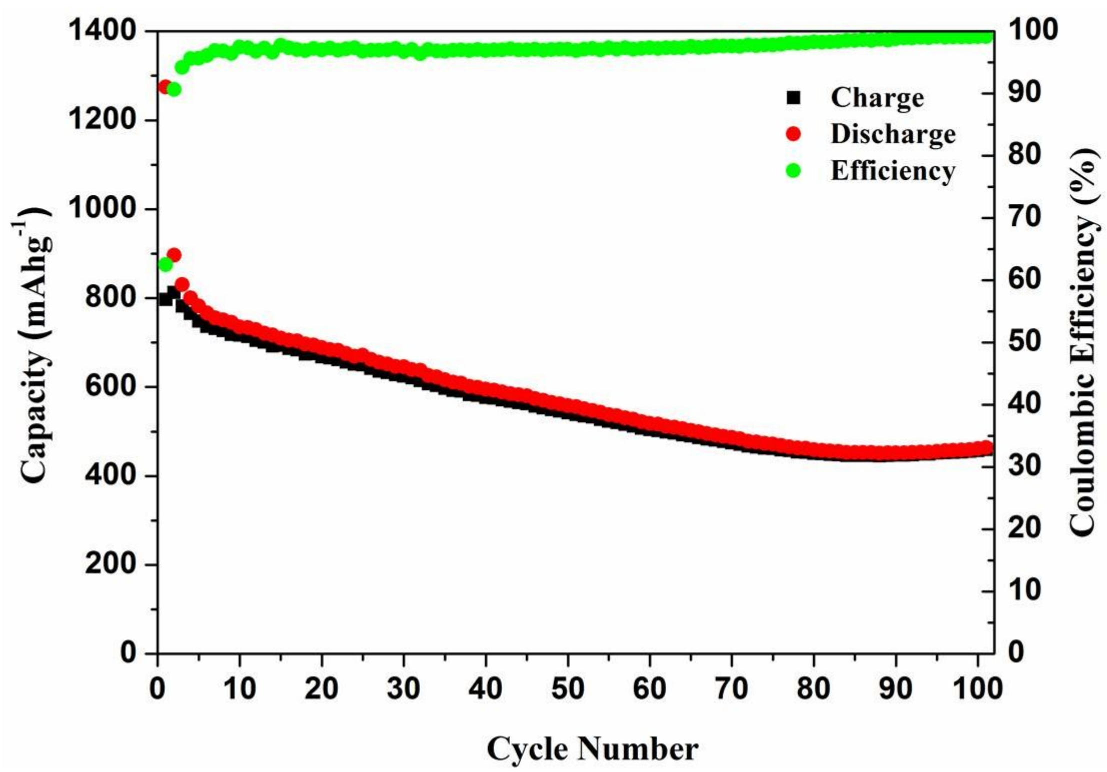

Fig. S9 Charge-discharge curve of the electrode made of SOC-3 at 500 mA g^{-1}.

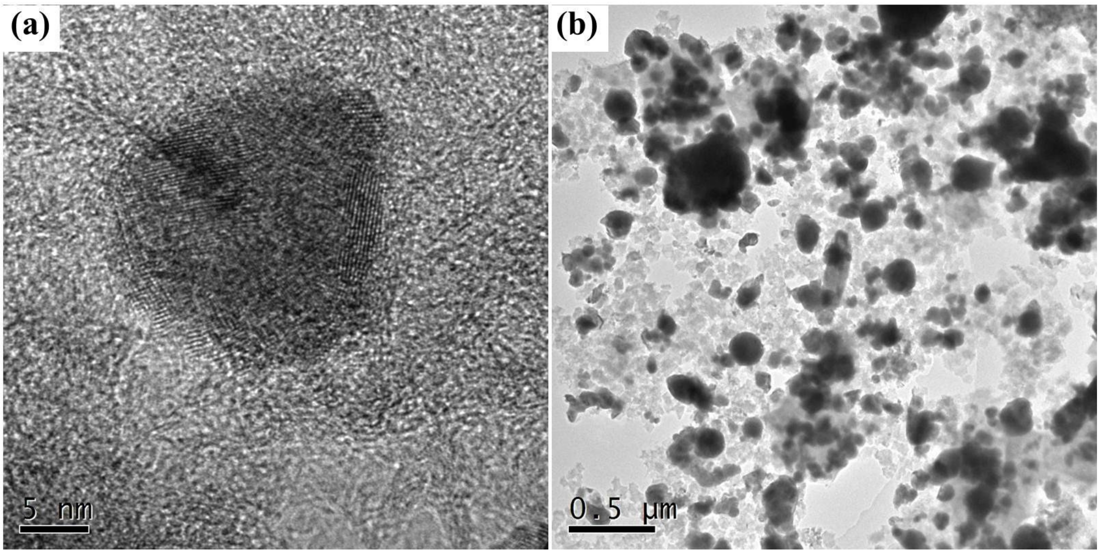

Fig. S10 TEM image of SOC-3 after tenth cycle in the current density of 500 mA g^{-1}.

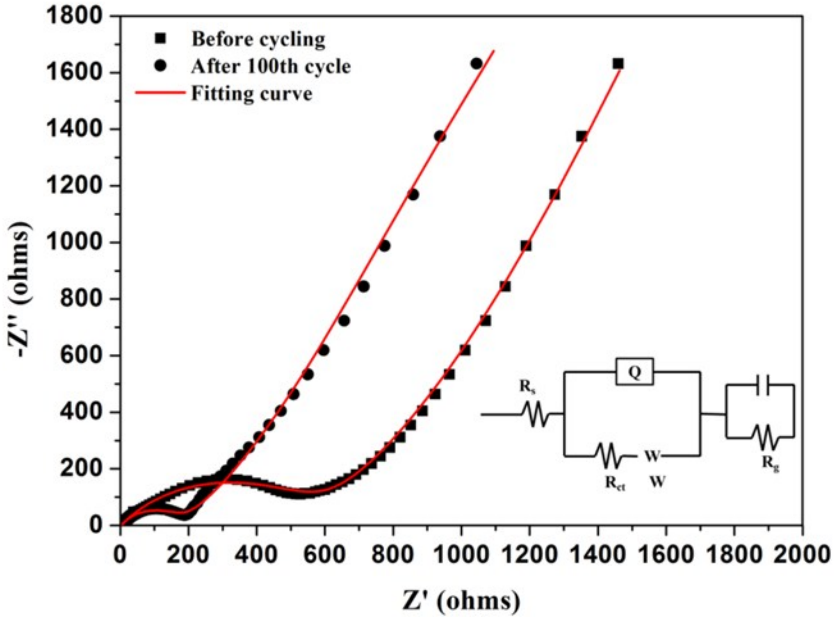

Fig. S11 The electrochemical impedance spectra of SOC-3.

Table S1 The carbon, nitrogen, and hydrogen contents of precursors and calcination products from elemental analysis.

	C/%	N/%	H/%
SOZ-1	33.45	19.00	3.44
SOZ-2	27.51	14.27	3.29
SOZ-3	22.77	11.76	3.08
SOC-1	23.51	4.74	1.25
SOC-2	19.11	5.99	1.04
SOC-3	17.33	4.16	1.06

Table S2 The capacities of selected SnO_2-based anode materials in lithium-ion batteries.

Active material	Synthesis route	SnO_2 size (nm)	Capacity (mA h g^{-1})/ Current density (A g^{-1})/ Cycle Number
SnO_2@C (This work)	**ultrasonication and pyrolysis**	**2-4**	**1032/0.1/150**
SnO_2@C[42]	Introduction and pyrolysis	5-10	880/0.1/200
3D SnO_2/graphene foam[53]	ultrasonic, freeze-drying, anneal	6-12	533.7/1/150
Reduced graphene oxide/SnO_2[54]	microwave irradiation and anneal	100-200	649/0.05/30
Carbon-Coated SnO_2 Nanocolloids[55]	hydrothermal and calcined	50-70	440/0.1/300
SnO_2@polypyrrole Nanotubes[56]	microwave-assisted and pyrolysis	2-3	790/0.2/200
Graphene-SnO_2-carbon[57]	hydrothermal and anneal	28-50	878/0.05/50
Polypyrrole (PPy)-derived SnO_2[58]	hydrothermal and calcination	5-10	598.3/0.1/50
N-doped graphene-SnO_2[59]	stirring and thermally treated	2-3	910/0.05/50
PANI-coated SnO_2/graphene[60]	in situ polymerization	4-8	502/1/100
graphene-based SnO_2[61]	solvothermal	3.8-5	847/0.0782/50
SnO_2/Layed Carbon[62]	polymerization and pyrolysis	50-70	700/0.1/115
bowl-likeSnO_2@carbon[63]	template and calcination	900	963/0.4/100
SnO/SnO_2/GNS[64]	sonication and refluxing	<30	508/0.1/30
SnO_2 nanoparticles[65]	stir and calcination	30-50	541.8/0.4/100
SnO_2@MIL-101(Cr)[66]	stir and heat treatment	<50	510/0.079/100
SnO_2/NiO Nanotubes[67]	Electrospinning, calcination and electrospinning method	20-26	826/1/500
SnO_2 hollow nanoplate[68]	spray pyrolysis and thermal oxidation	5-50	598/0.5/600