Supporting information (SI)

Oxygen Vacancies Enable Excellent Electrochemical Kinetics of Carbon Coated Mesoporous SnO_2 Nanoparticles in Lithium Ion Battery

Boya Venugopal[a,f,1*], Parakandy Muzhikara Pratheeksha[a,d,1], Khasim Saheb Bayikadi[e], Pavan Srinivas Veluri[a], Mantripragada Rama Krishna[b], Bulusu Venkata Sarada[c], Tata Narasinga Rao[a], Paul Joseph Daniel[d] and Srinivasan Anandan[a*]

[a] Centre for Nanomaterials, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad-500005, India.

[b] Centre for Material Characterization and Testing, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad-500005, India.

[c] Center for Solar Energy Materials, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad-500005, India.

[d] Department of Physics-National Institute of Technology, Warangal-506 004, India.

[e] Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei 10617, Taiwan.

[f] Department of Engineering and System Science, National Tsing Hua University, Hsinchu, 30013, Taiwan.

Corresponding Authors

Email id: b.venugopal77@gmail.com and anandan@arci.res.in

[1] These authors contributed equally to this work

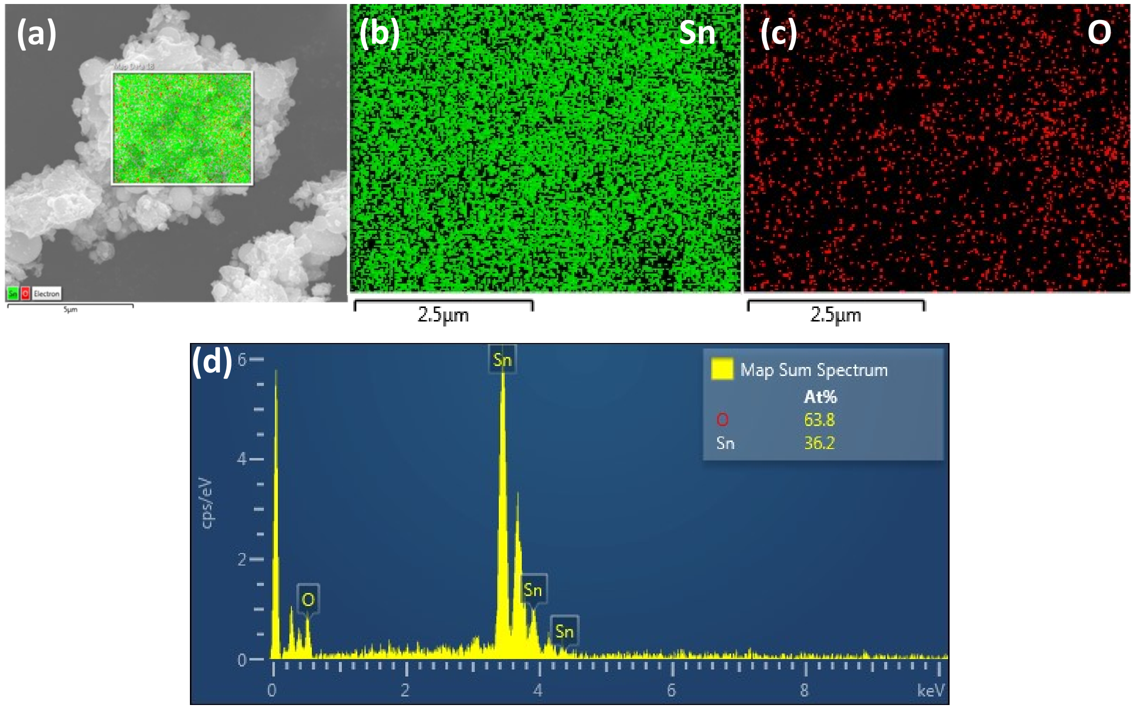

Fig. S1 (a) SEM image of H-SnO_2 particles (calcined at 400 °C), (b-c) elemental mapping of Sn and O (d) EDS analysis of H-SnO_2

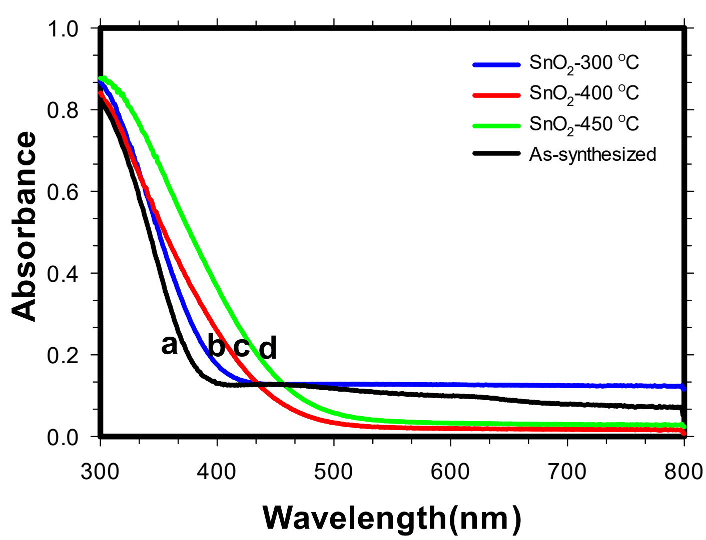

Fig. S2: UV-vis- absorption spectrum of (a) H-SnO_2 As-synthesized, H-SnO_2 calcined at (b) 300 ˚C, (c) 400 ˚C and (d) 450 ˚C.

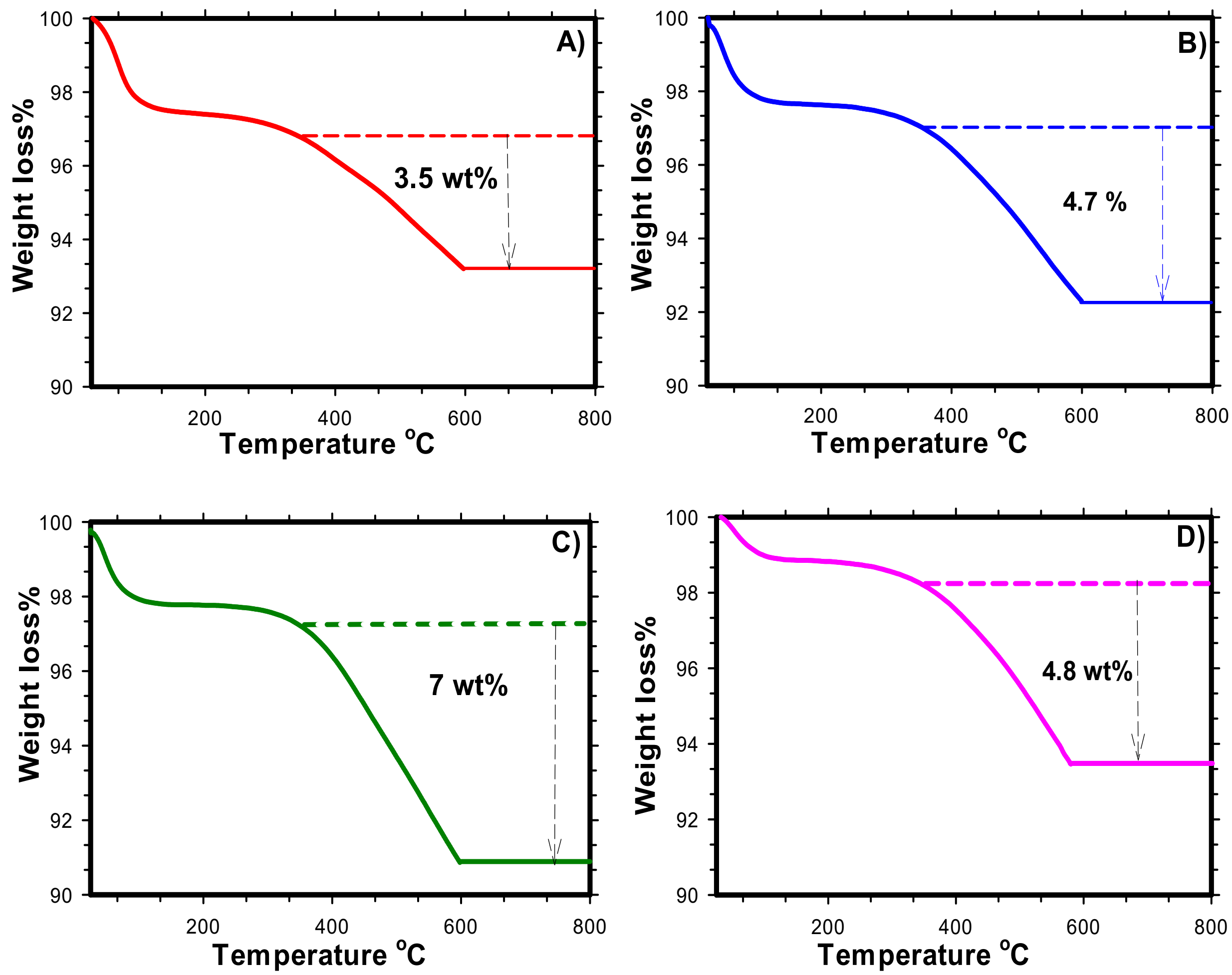

Fig. S3: TGA curves of the non-conventional carbon coated H-SnO_2: (a) NCC-1 (b) NCC-2 (c) NCC-3 and (d) NCC-4.

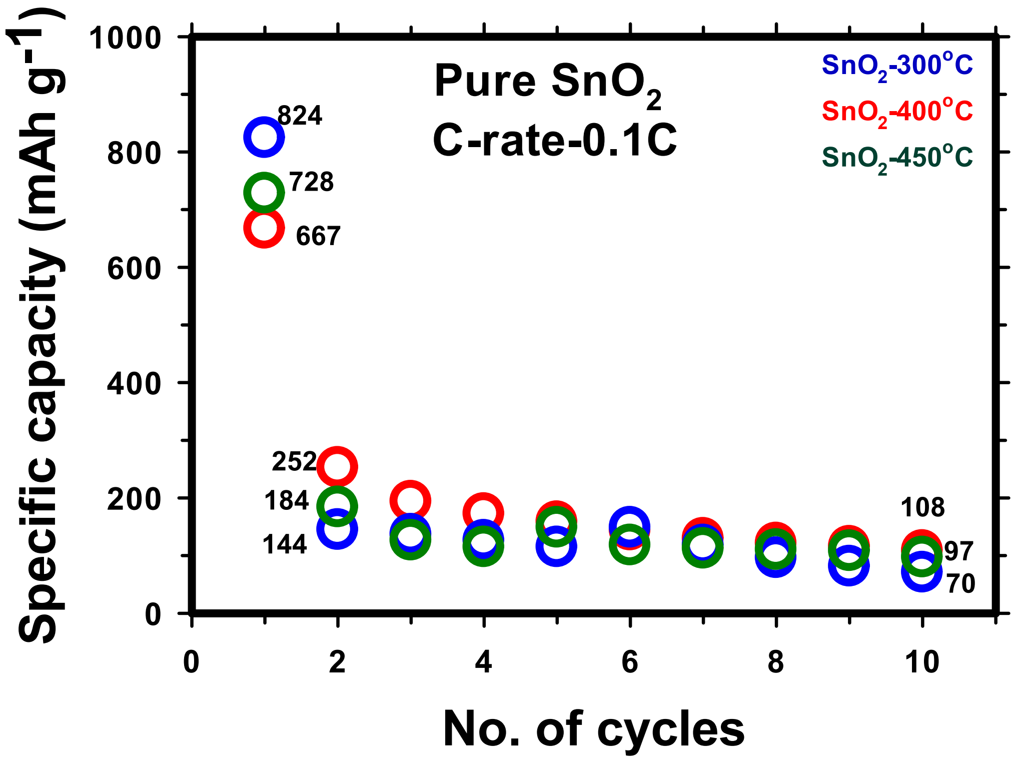

Fig. S4: Cyclic stability of pure SnO_2 tested at 0.1C rate

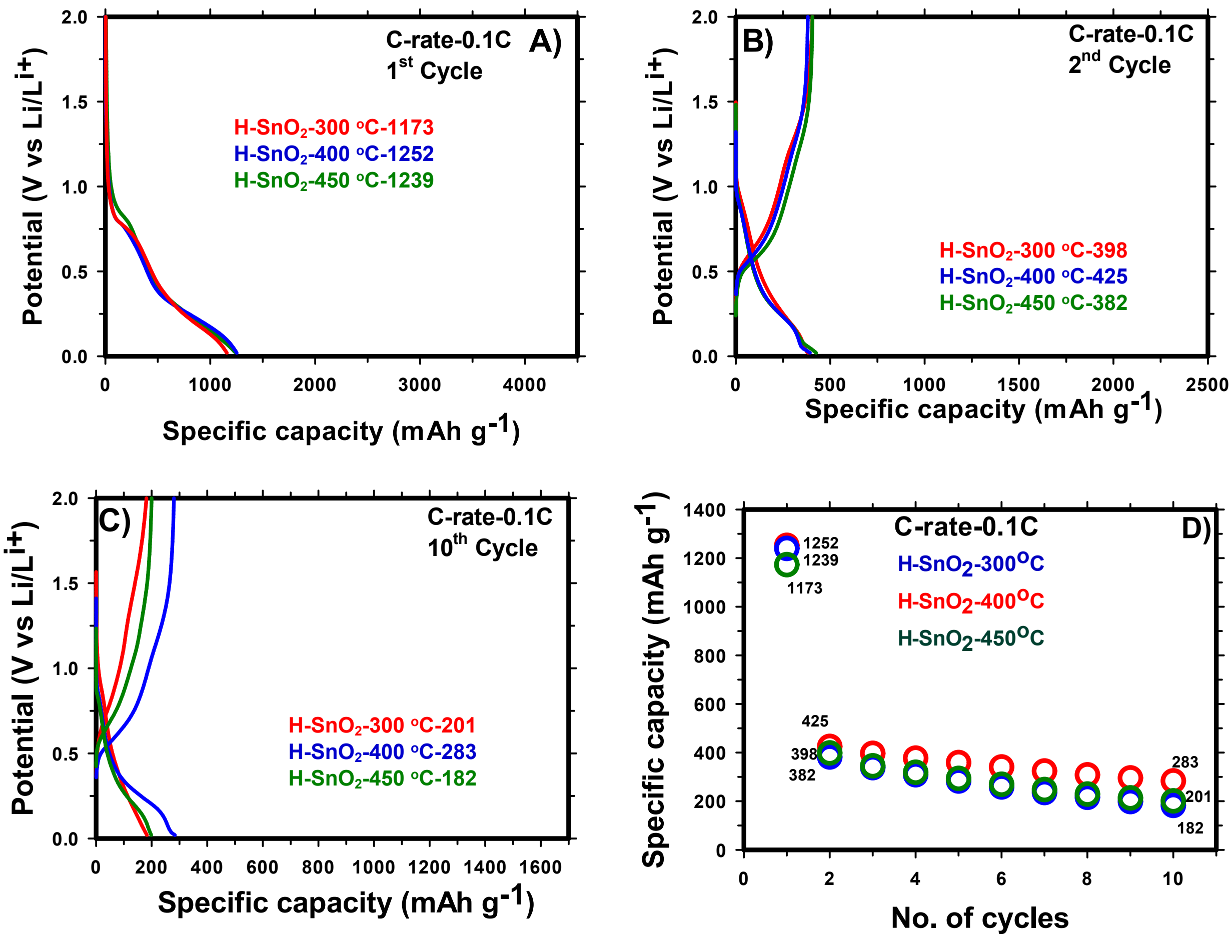

Fig. S5: Electrochemical performance of H-SnO_2 calcined at 300 °C, 400 °C and 450 °C tested at 0.1C (A) 1st cycle, (B) 2nd cycle and (C) 10th cycle and (D) cyclic stability of H-SnO_2 calcined at 300 °C, 400 °C and 450 °C

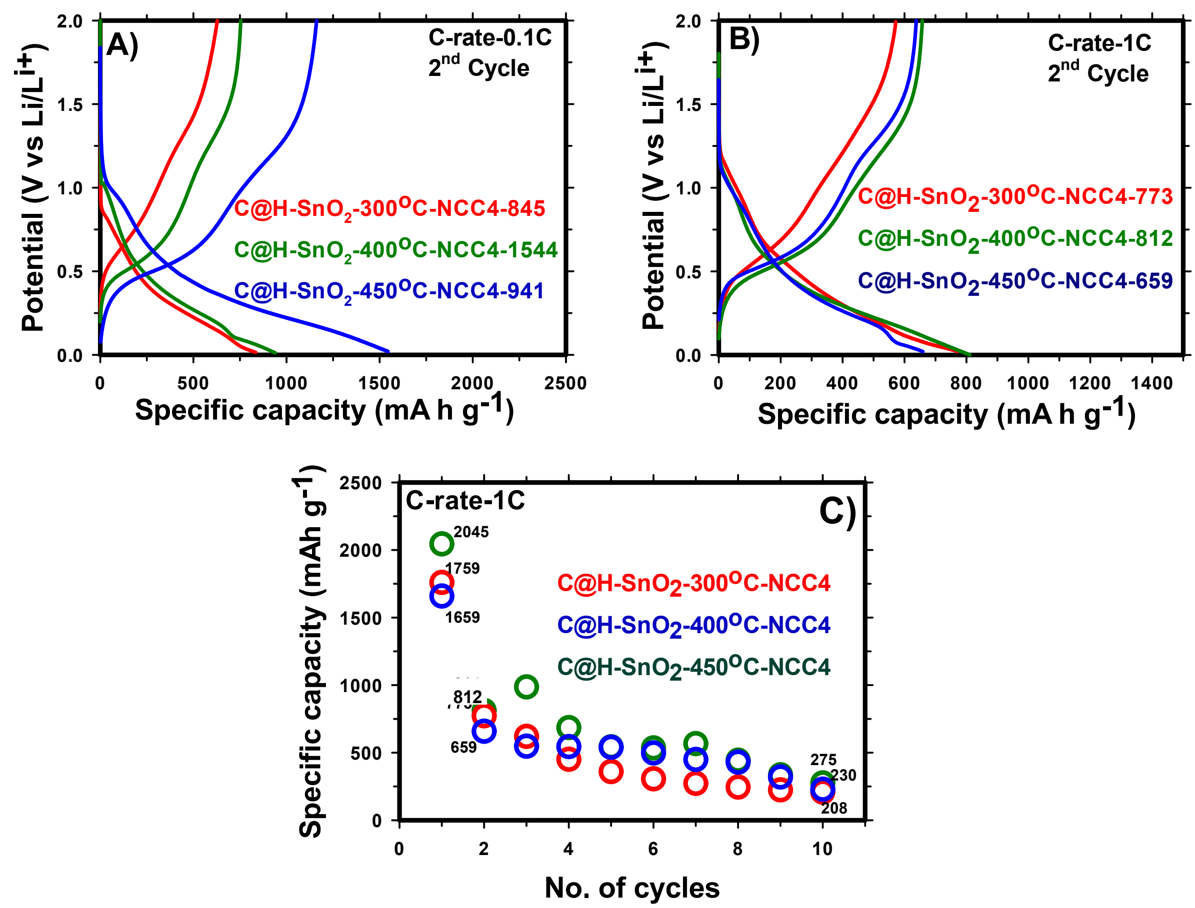

Fig. S6: Charge-discharge profile of carbon coated H-SnO_2 calcined at 300, 400 and 450 °C carbon coated by NCC-4 tested at (A) 0.1C, (B) 1C, (C) cyclic stability tested at 1C rate

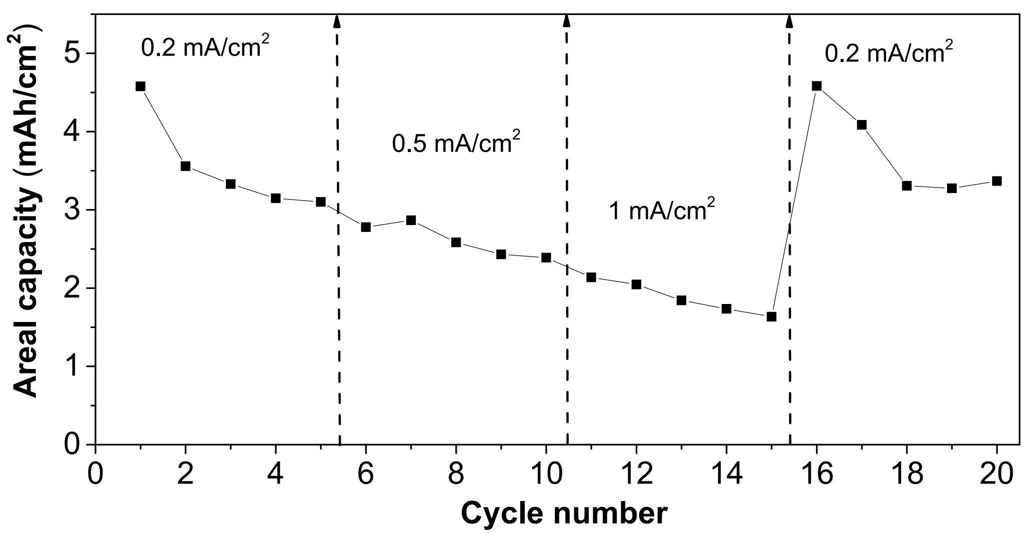

Fig. S7 Rate performance of C@H-SnO_2-400 °C-NCC4

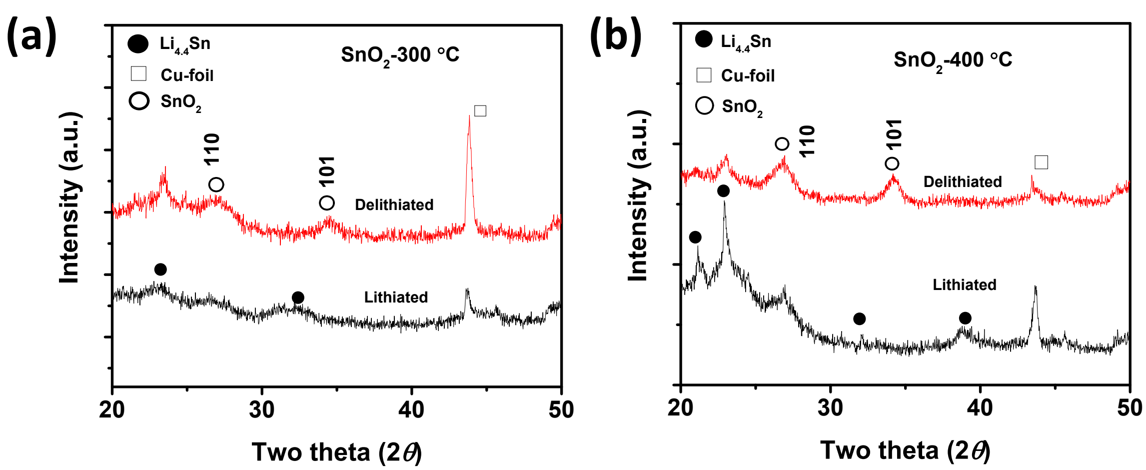

Fig. S8: XRD pattern for H-SnO_2 calcined at (a) 300 °C (b) 400 °C carbon coated by NCC-4

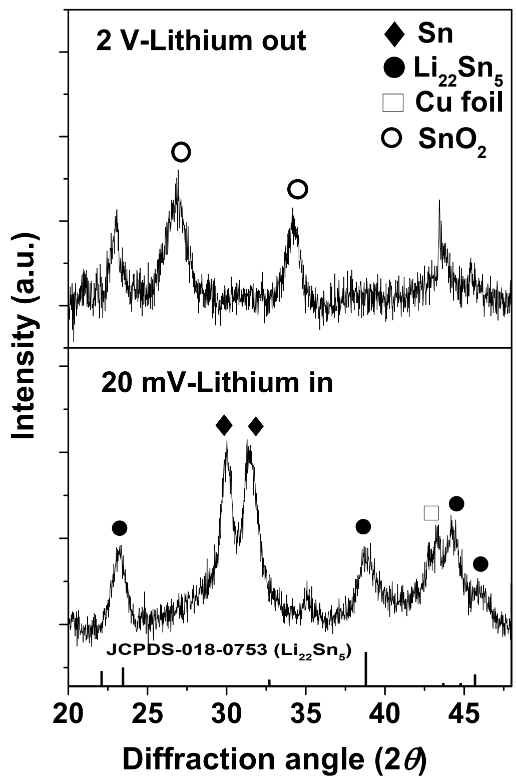

Fig. S9. Ex-situ XRD of H-SnO_2 after 50 cycles.

Table S1: XRD data of pure H-SnO_2 calcined at different temperatures and C@H-SnO_2 nanoparticles, UV-Vis data with UV-vis and TGA results

Sample	Crystallite size (nm)	Lattice Parameters		Unit cell volume (Å^3)	Band gap (e.V)	Carbon content (TGA)
		a=b	c			
H-SnO_2-300 ˚C	4.5	4.7311	3.1867	71.33	3.03	
H-SnO_2-400 ˚C	5.1	4.7342	3.186	71.4	2.76	
H-SnO_2-450 ˚C	6.8	4.7381	3.186	71.54	2.51	
C@H-SnO_2-NCC1	7.4	4.7461	3.189	71.8		3.5%

$C@H\text{-}SnO_2$-NCC2	7.3	4.7459 3.1752	71.52		4.7%
$C@H\text{-}SnO_2$-NCC3	7.1	4.708 3.189	71.4		7.0%
$C@H\text{-}SnO_2$-NCC4	7.7	4.7581 3.175	71.9		4.8%

Table S2. XPS core level of Sn3*d*, O1*s* and C1*s* of $C@H\text{-}SnO_2$ NPs by CC1 and NCC4 condition

Sample	Crystallite size (nm)	Binding energy (eV)	Binding energy (eV) C 1s	Δ (eV) for Sn 3d	Binding energy (eV)
		Sn-3$d_{5/2}$ and		(spin-orbit	O-1s
		Sn-5$d_{3/2}$		coupling)	(Deconvoluted)
$C@H\text{-}SnO_2$-CC	4.5	487.087	284.5	8.417	530.909
		495.310	286.199		531.587

C@H-SnO_2-NCC4	7.7	486.671	284.5	8.031	530.617
		495.210	285.437		532.179
			288.629		

.