Nanostructured SnO_2/Ni/CNT composite as an anode for Li ion battery

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Figure S1: X-ray diffraction patterns of SnO_2/Ni composite with 2% & 6%Ni i.e. SnNi-2% and SnNi-6%, SnO_2/CNT with 0.5% & 1.5%CNT i.e. SnCn-0.5% and SnCn-1.5%, SnNiCn composites with 2% & 6% Ni having 1% CNT i.e. SnNiCn-2% Ni & SnNiCn-6% Ni.

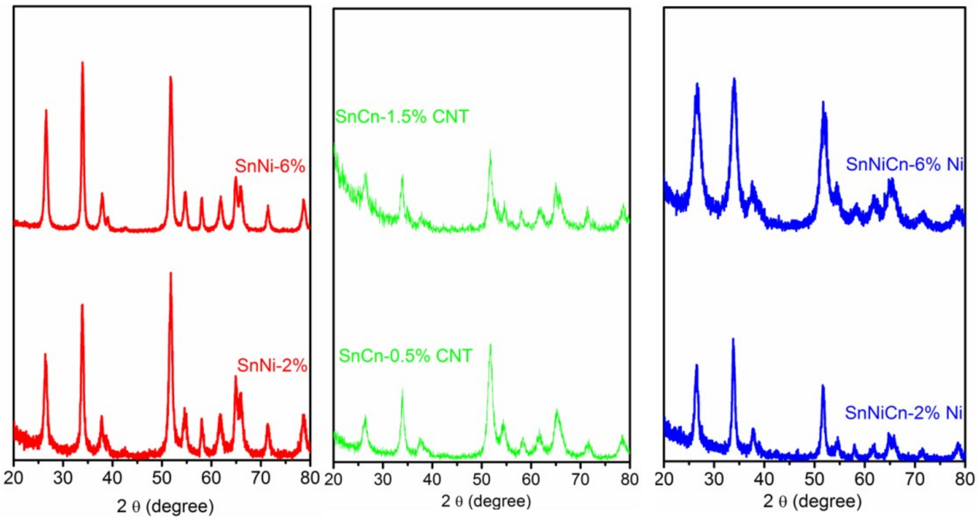

Figure S2: FESEM images of SnNi: SnO_2/Ni (a:2% &b:6%), SnCn: SnO_2/CNT (c:0.5% &d:1%), SnNiCn: SnO_2/Ni/CNT (1% CNT with e:2% &f: 6% Ni) nanocomposites.

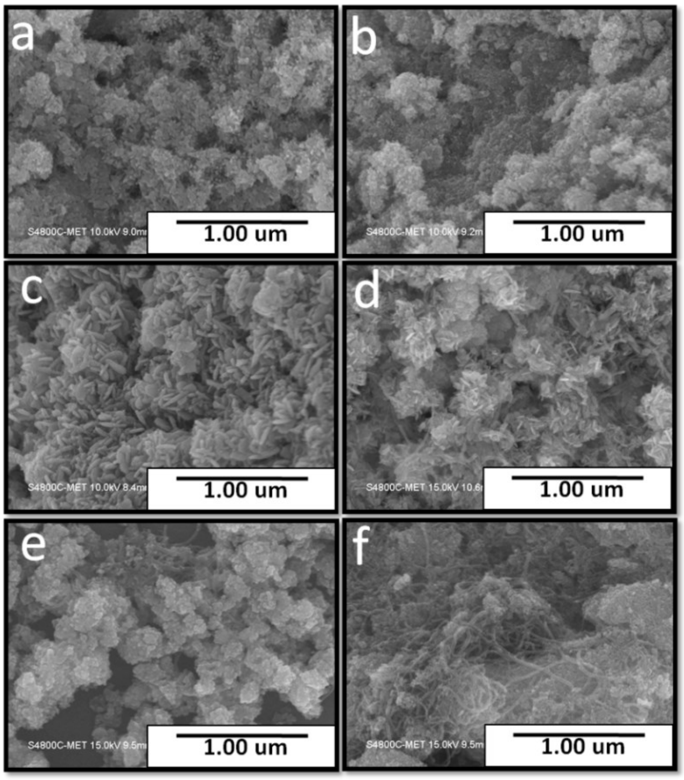

Figure S3: The rate performance at different current densities of all samples between 0.005 and 3V (a) SnNi-2% , 4%, 6% (b) SnCn-0.5% , 1%, 1.5% and (c) SnNiCn- 2%, 4%, 6%

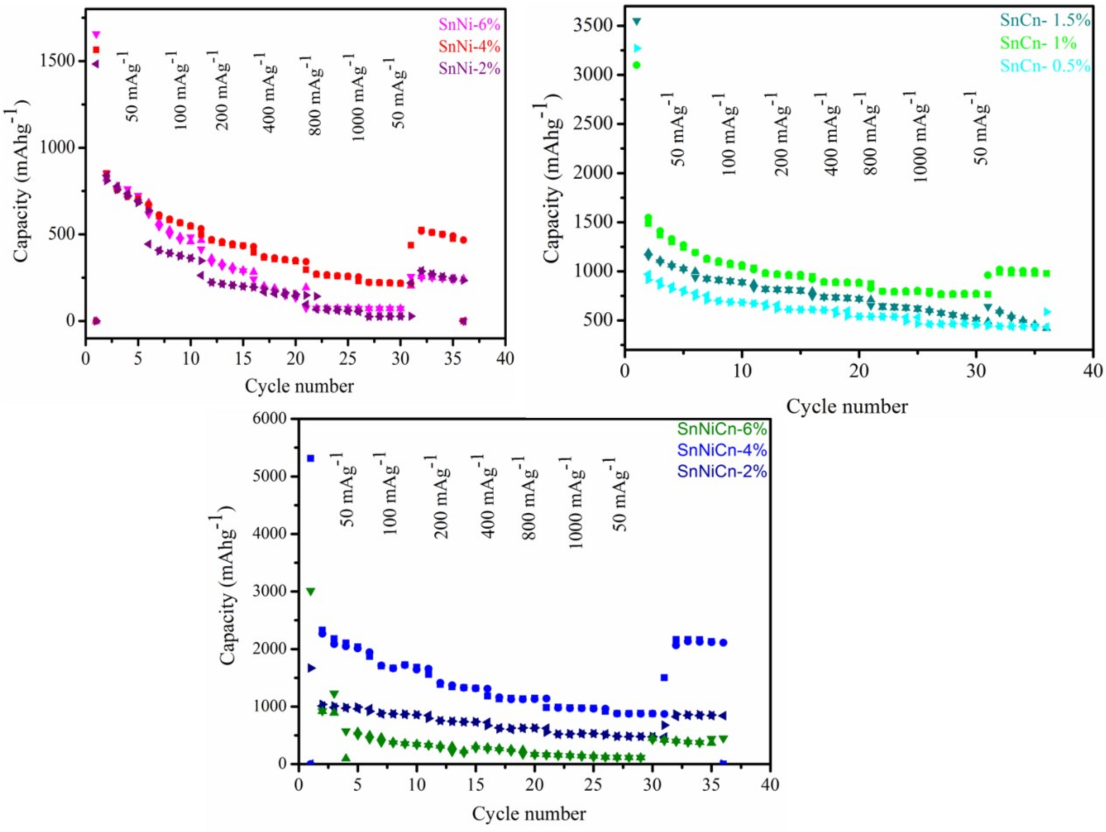

Figure S4: Calculation of Li+ ion diffusion from the relationship between Zre and ω-1/2 in the low frequency region using the following equations.

$$Z_{re} = R_s + R_{ct} + \sigma_w \omega^{-1/2}$$

$$D = \frac{R^2 T^2}{2A^2 n^4 F^4 C^2 \sigma_w^2}$$

Where,

ω is angular frequency in the low frequency region,

σ Warburg coefficient,

σw represents the Warburg impedance coefficient,

D is Li+ diffusion coefficient, R is gas constant,

T is absolute temperature,

A is area of electrode surface,

n is the number of the electrons per molecule participating in the electronic transfer reaction,

F is Faraday constant and

C is the molar concentration of Li^+.

According to the equation, the smaller the σ is, the higher the diffusion coefficient of lithium ion is, where σ is the slope of the plot of Z' Vs $\omega^{-1/2}$ at low frequency region.

Figure S5: FESEM images of electrodes of SnNiCn (1% CNT and 4% Ni) composite after 200 cycles at the current density of 400 mAg^{-1}

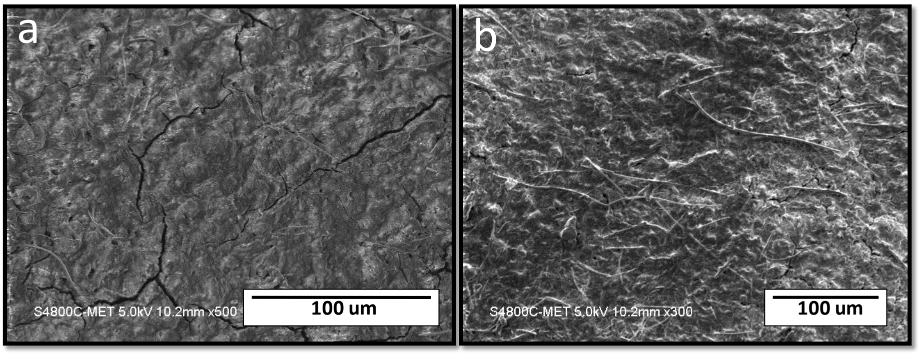

Figure S5 shows the FESEM images of SnNiC electrode after 200 cycles at the current density of 400mAg^{-1}. Careful investigation shows the SnNiC electrode have negligible cracks due to the CNT. It reveals that the optimum percentage of CNT and Ni gives superior mechanical strength to the nanoparticles and prevents cracking during volume expansion of SnO_2.Which in turn result in stable capacity with no negligible fading in capacity.

Figure S6: Size distribution diagram of SnNiCn composite.

The Size distribution of SnNiCn composite is diagram is given below.

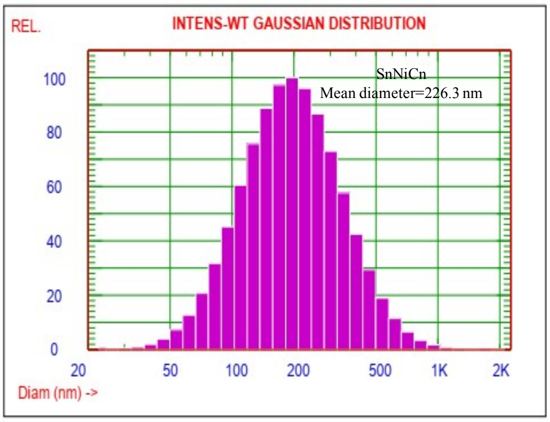

Figure S7 : Higher magnification images of SnNiCn composites