# Electronic Supplementary Information (ESI)

# Steady cycling of lithium metal anode enabled by alloying Sn-modified carbon nanofibers

Cuimei Fu,‡[a] Hao Yang,‡[a] Pengfei Jia,[a] Chengcheng Zhao,[a] Lina Wang,*[a] and Tianxi Liu*[a,b]

a. State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, China.

b. Key Laboratory of Synthetic and Biological Colloids, Ministry of Education, School of Chemical and Material Engineering, Jiangnan University, Wuxi 214122, China.

‡. These authors contributed equally.

*Correspondence and requests for materials should be addressed to L.W. (email: linawang@dhu.edu.cn) or to T.L. (email: txliu@dhu.edu.cn).

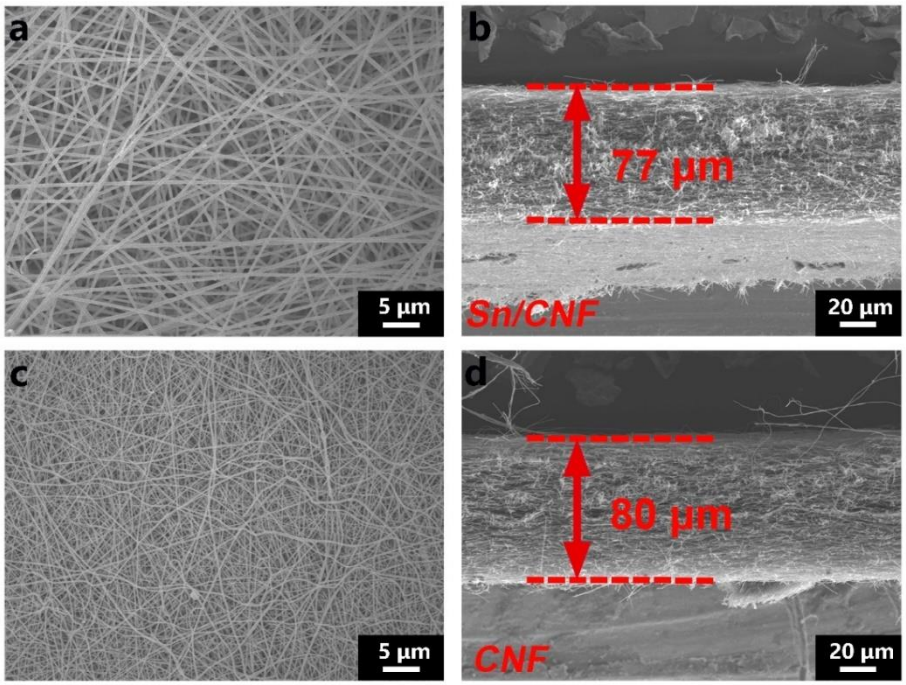


**Fig. S1** The top-view and cross-sectional SEM images of (a and b) Sn/CNF and (c and d) CNF films.

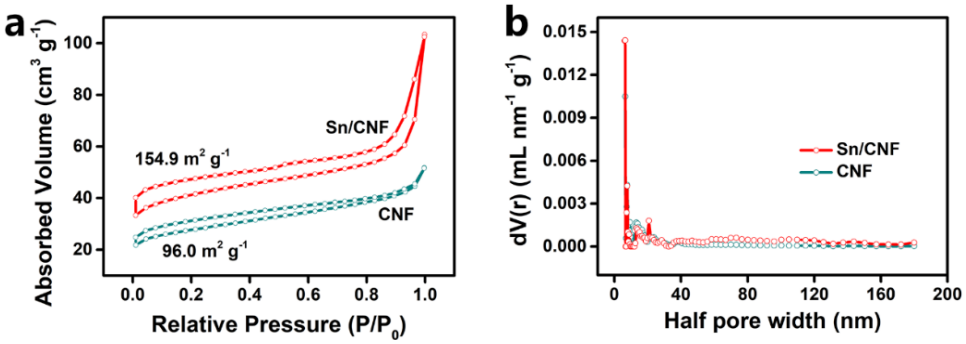


**Fig. S2** (a) $N_2$ adsorption isotherms of Sn/CNF and CNF films and (b) the corresponding pore size distribution curves.

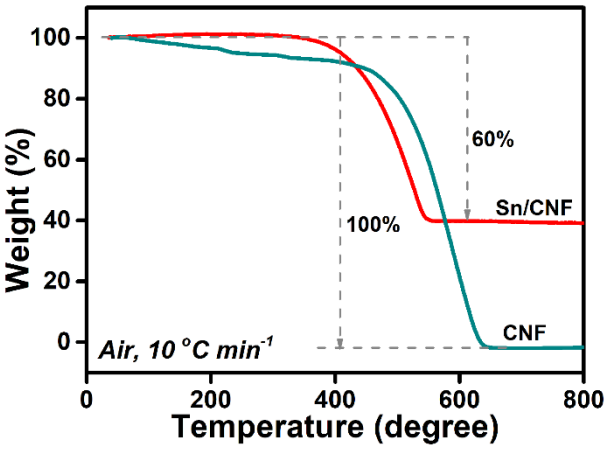


**Fig. S3** TGA curves of Sn/CNF and CNF films under air atmosphere at 10 °C $min^{-1}$.

During TGA testing, Sn is oxidized to $SnO_2$ under air atmosphere after annealing above 220 °C.[1,2] The calculated Sn content is based on the following Equation S1:

$$Sn + O_2 \rightarrow SnO_2 \quad (S1)$$

The mass increase of Sn transformed into $SnO_2$ is 27%. We supposed the mass percentage of Sn in the Sn/CNF is m, so the remainder mass percentage attributed to the weight decrease is (1–m). According to the computational formula:

$$1 - m - 27\%\ m = 60\%$$

Then, we can get m = 32%.

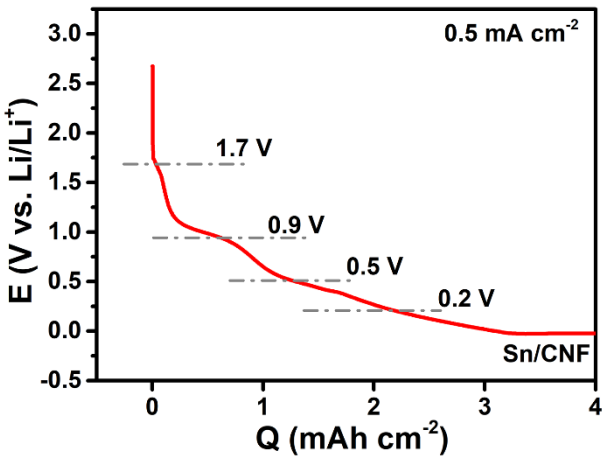


**Fig. S4** The magnified view of voltage–capacity profile of Sn/CNF at 0.5 mA $cm^{-2}$ for Sn/CNF.

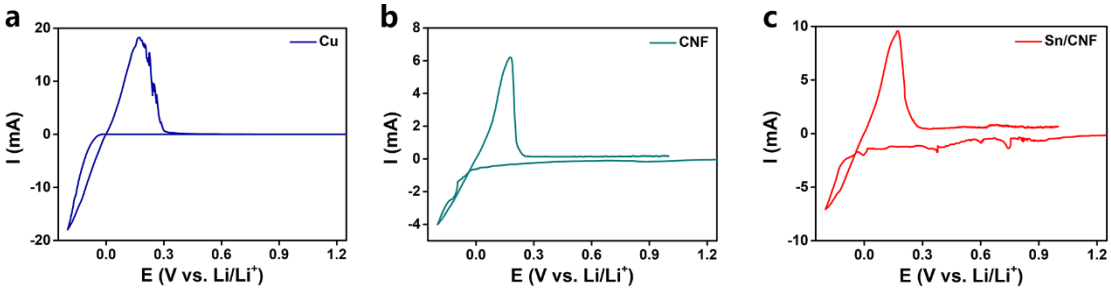


**Fig. S5** Cyclic voltammetry scan of (a) Cu, (b) CNF and (c) Sn/CNF with a counter electrode of Li metal at a scan rate of 0.05 mV $s^{-1}$.

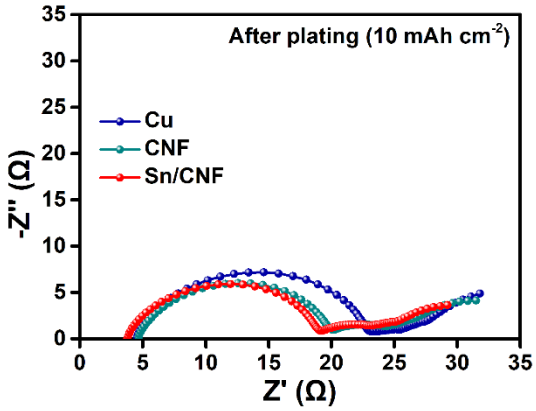


**Fig. S6** The Nyquist plots of Sn/CNF||Li, CNF||Li and Cu||Li cells after plating of 10 mAh $cm^{-2}$ Li.

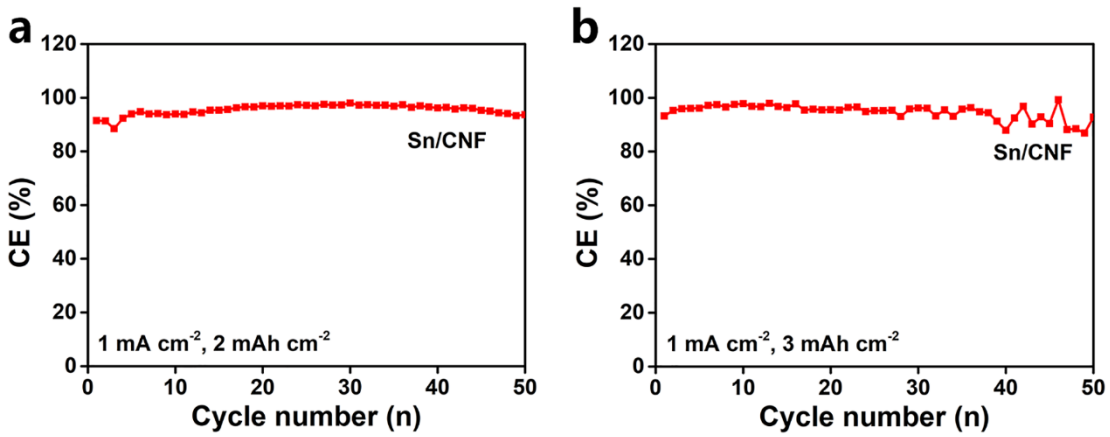


**Fig. S7** Coulombic efficiency for Li deposition/stripping in Sn/CNF||Li half cells at the current density of 1 mA $cm^{-2}$ with the capacity of (a) 2 mAh $cm^{-2}$ and (b) 3 mAh $cm^{-2}$.

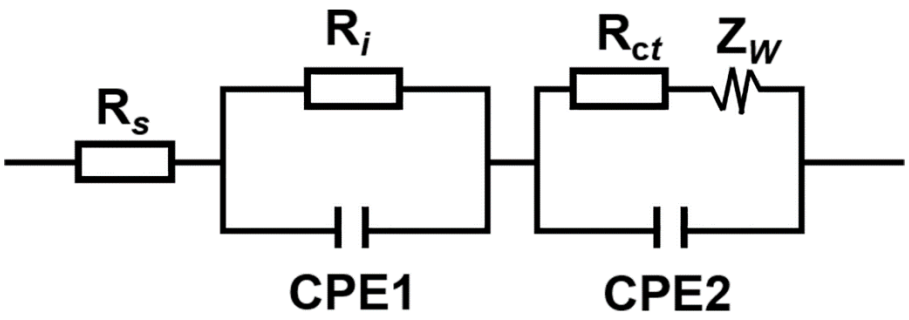


**Fig. S8** The simplified equivalent circuit for fitting the impedance spectra of EIS plots.

**Table S1.** The fitted electrochemical resistance values of Sn/CNF@Li, CNF@Li and Cu@Li electrodes for symmetrical cells.

| Sample | State | $R_s$ (Ω) | $R_i$ (Ω) | $R_{ct}$ (Ω) |
|---|---|---|---|---|
| Sn/CNF@Li | Fresh | 5.9 | 12.7 | 4.1 |
| | 10th cycle | 4.3 | 4.3 | 1.8 |
| CNF@Li | Fresh | 4.6 | 33.8 | 27.0 |
| | 10th cycle | 5.2 | 11.1 | 2.6 |
| Cu@Li | Fresh | 4.6 | 46.5 | 48.0 |
| | 10th cycle | 7.3 | 11.2 | 6.4 |

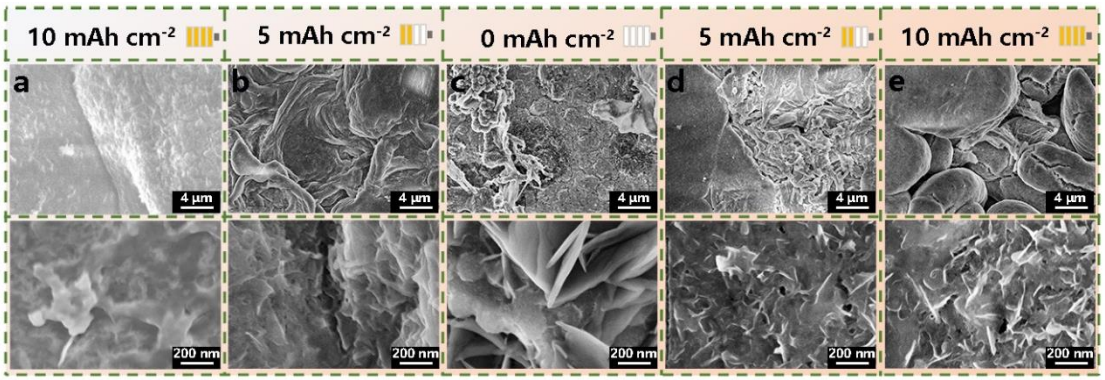


**Fig. S9** SEM images of Cu foil at different Li plating/stripping states for (a) plating 10 mAh $cm^{-2}$, (b) stripping 5 mAh $cm^{-2}$, (c) stripping 10 mAh $cm^{-2}$, (d) further plating 5 mAh $cm^{-2}$ and (e) plating 10 mAh $cm^{-2}$.

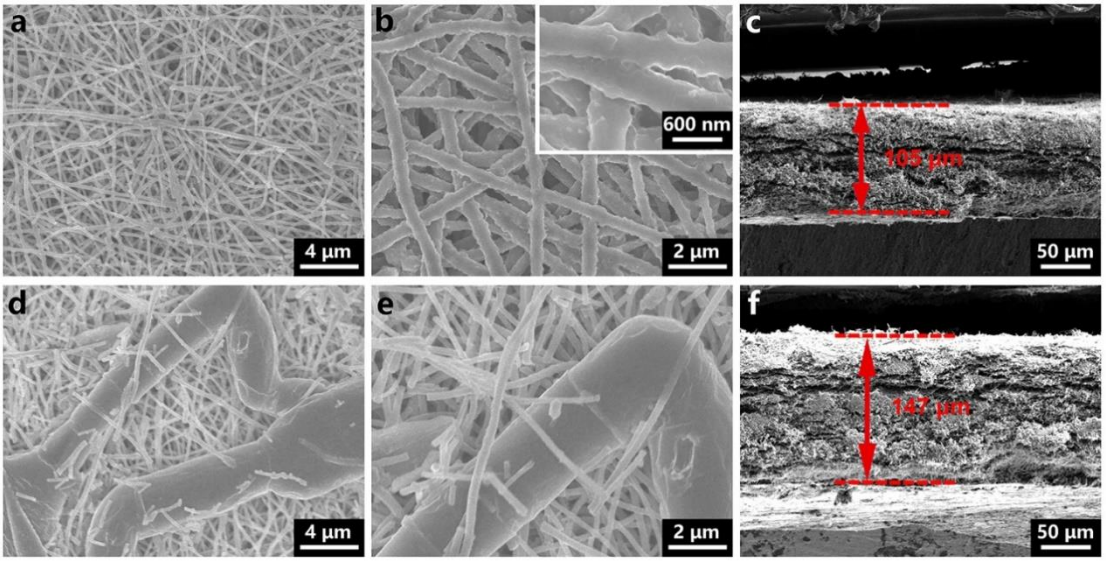


**Fig. S10** SEM images of of (a–c) Sn/CNF@Li and (d–f) CNF@Li electrodes after 50 cycles at 1 mA $cm^{-2}$ with a fixed capacity of 1 mAh $cm^{-2}$ for symmetrical cells.

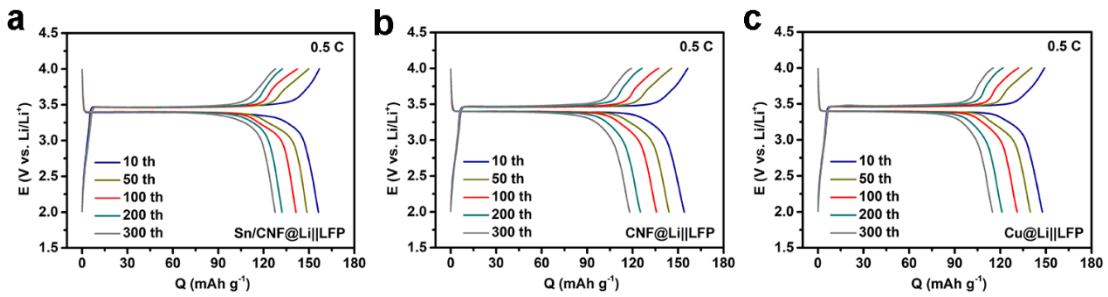


**Fig. S11** Typical charge–discharge profiles of (a) Sn/CNF@Li||LFP, (b) CNF@Li||LFP and (c) Cu@Li||LFP at 0.5 C.

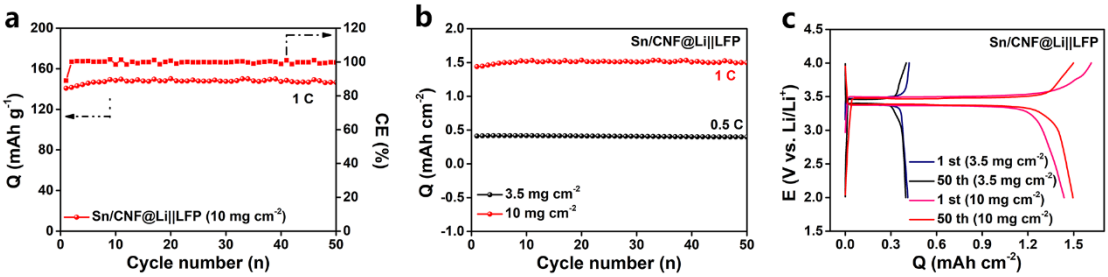


**Fig. S12** (a) Cycling performance of Sn/CNF@Li||LFP cell at 1 C with LFP cathode loading of 10 mg $cm^{-2}$. (b) Area capacity comparison and (c) the voltage–area capacity profiles of the cells with different loadings of LFP.

## References

S1 N. Zhang, Q. Zhao, X. Han, J. Yang and J. Chen, *Nanoscale*, 2014, **6**, 2827-2832.

S2 H. Zhang, X. Huang, O. Noonan, L. Zhou, C. Yu, *Adv. Funct. Mater.*, 2017, **27**, 1606023.