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# [Electronic Supplementary Information]

# Titanium Nitride Coating to Enhance the Performance of Silicon Nanoparticles as a Lithium-Ion Battery Anode

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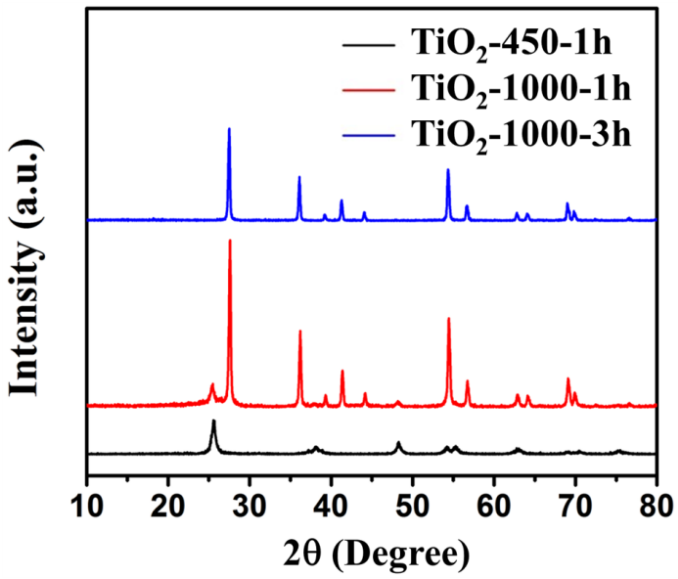


**Fig. S1.** XRD patterns of $TiO_2$-450-1h, $TiO_2$-1000-1h, and $TiO_2$-1000-3h.

To demonstrate that the silicon can act as the catalyst, we synthesized the $TiO_2$ through the same procedure of Si@$TiO_2$, but without the addition of silicon. This $TiO_2$ was thermally annealed in a in a tube furnace at 450 $^oC$ for 1 h under nitrogen stream, this material was named $TiO_2$-450-1h. And then $TiO_2$-450-1h was annealed at 1000 $^oC$ for 1h and 3 h, respectively under nitrogen stream, these two samples were named $TiO_2$-1000-1h and $TiO_2$-1000-3h, respectively. As shown in Figure 1S, all the peaks of $TiO_2$-450-1h can be assigned to the anatase phases and all the peaks of $TiO_2$-1000-3h can be assigned to the rutile phases. We can draw a conclusion that, the $TiO_2$ could not react with $N_2$ to form the TiN without the silicon at 1000 $^oC$. The overall reaction to form TiN at 1000 $^oC$ is denoted in the following equations:[S1]

$$3Si + 2N_2 = Si_3N_4, \quad (1)$$

$$Si_3N_4 + TiO_2 = TiN + N_2O + NO + 3Si. \quad (2)$$

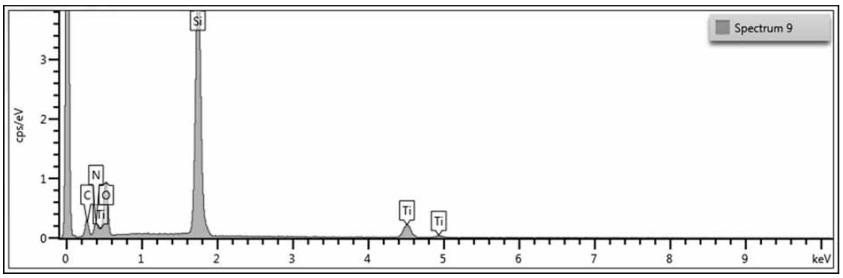


**Fig. S2.** EDS spectrum of Si@TiN.

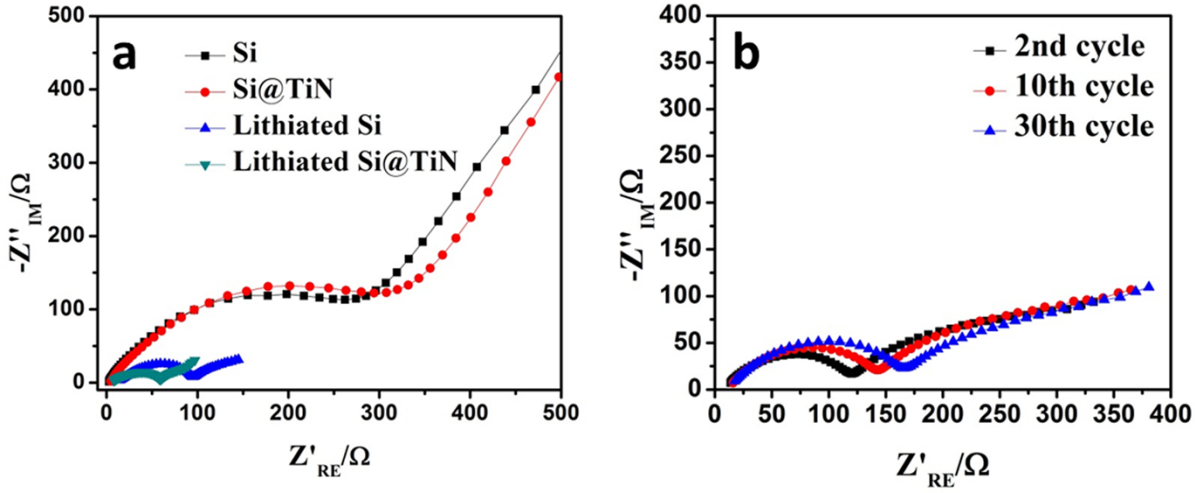


**Fig. S3.** (a) Nyquist plots of Li-ion cells using Si and Si@TiN electrodes at open circuit potential of approximately 2.90 V (vs. $Li^+/Li$) and using lithiated Si and lithiated Si@TiN electrodes after the initial discharge to the potential of approximately 0.05 V (vs. $Li^+/Li$). (b) Nyquist plots of Li-ion cells using Si@$TiO_2$ electrodes for cycles at 2nd, 10th and 30th.

## References

S1 Yu. F. Kargin, S. N. Ivicheva, A. S. Lysenkov, N. A. Ovsyannikov, L. I. Shvorneva and K. A. Solntsev, *Inorg. Mater.* 2012, **48**, 897-902.