**Electronic Supplementary Material (ESI) for Nanoscale.**
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# Supporting Information to

# Highly cross-linked a-Si/Cu core-shell nanowires as durable anode for Li ion battery with long cycle life and high rate performance

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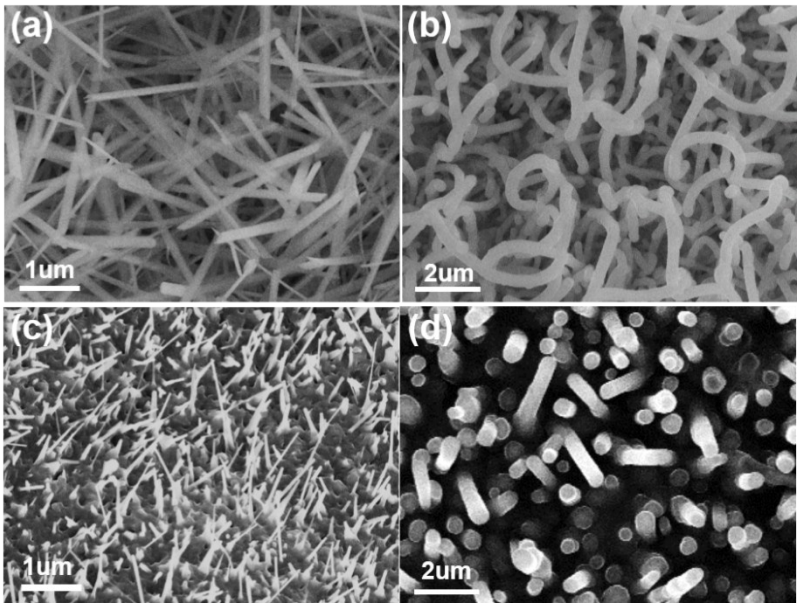


**Fig. S1** SEM image of the highly cross-linked structure and no cross-linked structure a-Si/Cu core-shell anode. (a) Highly crossing $Cu(OH)_2$ NWs by CBD (b) Highly cross-linked structure a-Si/Cu core-shell anode by a simple a-Si deposition. (c) Little crossing CuO NWs by thermal oxidation (d) No cross-linked structure a-Si/Cu core shell anode on the flat copper plate.

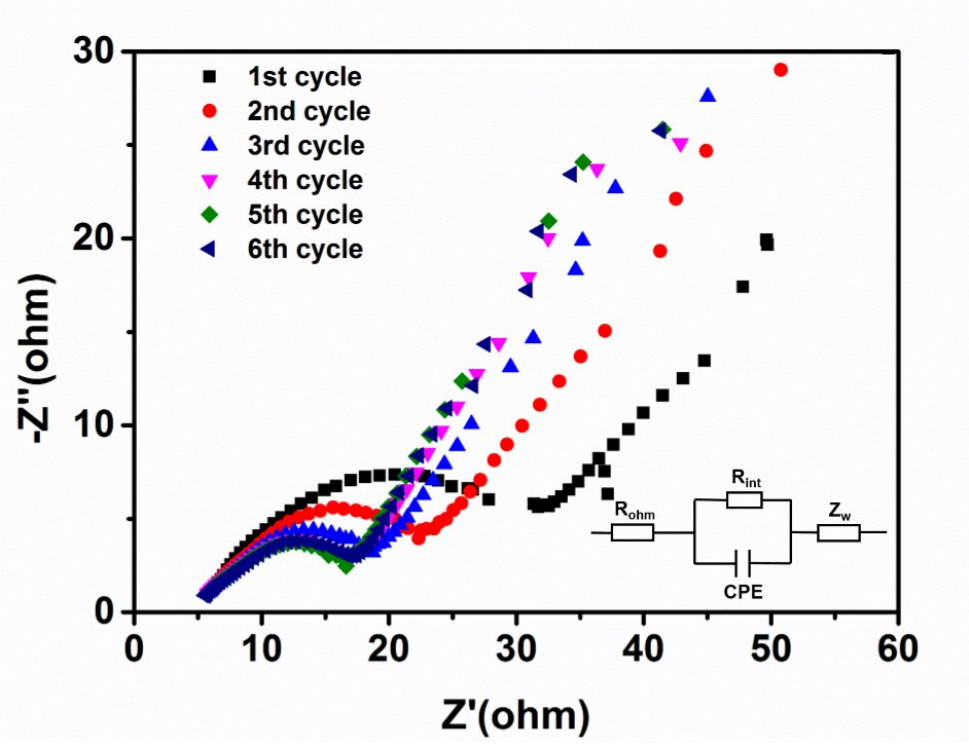


**Fig. S2** the EIS spectra of the Cu/a-Si core-shell LIBs during the first 6 runs of cycling.

**S.3/Table 1:** The electrochemical performance of core-shell nanowires structure.

| No. | Material & Structure | Cross-linked | Current density (A/g) | Cycles | Capacity after cycles (mAh/g) | Capacity retention | Reference & Journal and Year |
|---|---|---|---|---|---|---|---|
| 1 | CNT-Si composite | No | ~ 2 | 50 | ~ 980 | Capacity: 57% | Ref. [25] Adv. Mater, 2014 |
| | | | ~ 2-3-2 | 30 | ~1000 | Rate: 60% | |
| 2 | CNT-Si core shell wires | No | ~ 0.84 | 80 | ~ 2510 | Capacity: ~ 91% | Ref. [27] Nanoscale, 2013 |
| | | | **~ 0.84-50-0.84** | 77 | ~ 980 | **Rate: ~ 94%** | |
| 3 | CNT-Si nanowires | No | ~ 0.84 | 100 | 2502 | Capacity: ~ 90% | Ref. [26] Carbon, 2013 |
| | | | | | | | |
| 4 | a-Si/NiSix core-shell nanowire | No | --------- | 50 | 3000 | Capacity: ~ 83% | Ref.[24] Chem.Sci.,2011 |
| | | | | | | | |
| 5 | a-Si/NiSix core-shell nanowire with alumina | **Yes** | ~0.9 | 90 | 3000 | Capacity: ~ 100% | Ref.[23] J.Mater.Chem.,2012 |
| | | | | | | | |
| 6 | Highly-interconnected Si NWs on SS substrate | **Yes** | ~ 8.4 | 70 | ~ 1800 | Capacity: ~ 84% | Ref. [31] Adv. Energy. Mater, 2011 |
| | | | ~ 0.4-34-0.4 | 72 | ~ 420 | Rate: ~ 84% | |
| 7 | Si particles on $TiSi_2$ matrix | **Yes** | ~6 | 100 | ~ 1310 | Capacity: ~90% | Ref.[21] ACS Nano,2011 |
| | | | ~0.6-15-0.6 | 40 | ~ 800 | Rate : ~85% | |
| 8 | Cu-Si-$Al_2O_3$ nanoscale array grown on Cu substrate | No | ~1.4 | 100 | ~ 1560 | Capacity: ~90% | Ref. [30] Adv. Mater, 2011 |
| | | | ~0.3-70-0.3 | 61 | ~ 200 | Rate: ~76% | |
| 9 | *3D silicon on nanopillar copper anodes* | No | ~1.0 | 100 | ~ 1627 | Capacity: ~83% | Ref.[13] ACS Nano, 2014 |
| | | | ~40 | 300 | ~ 996 | Capacity: ~100% | |
| | | | ~1.0-40-1.0 | 80 | ~ 587 | Rate:~87% | |
| *10* | *Highly cross-linked Cu/a-Si core-shell nanowire* | **Yes** | ~ 3.6 | **700** | ~ 748 | Capacity: ~ 80% | This work |
| | | | ~1.0 | **1000** | ~ 1026 | Capacity: ~ 80% | |
| | | | **~ 0.7-44.8-0.7** | **320** | ~ 200 | Rate: ~ 80% | |