Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Synthesis and Electrochemical Properties of Silicon Nanosheets by DC Arc Discharge for Lithium-ion Batteries

Xiuhong Yu, Fanghong Xue, Hao Huang, Chunjing Liu, Jieyi Yu, Yuejun Sun, Xinglong Dong,* Guozhong Cao and Youngguan Jung*

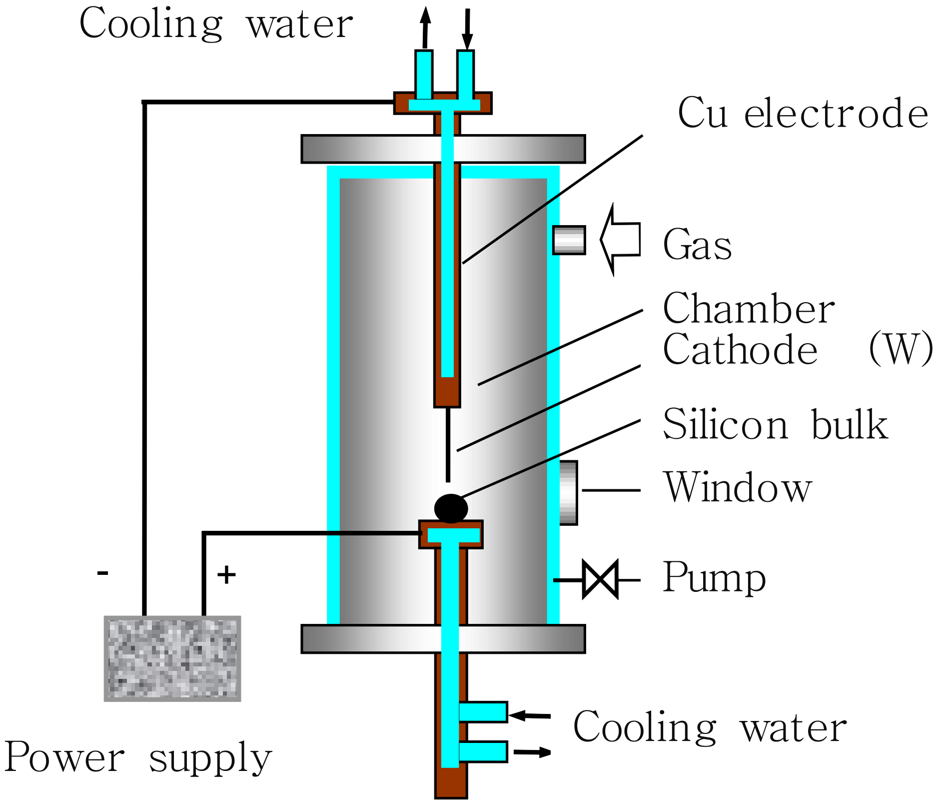


Figure S1. Schematic diagram of the hydrogen plasma DC-arc equipment

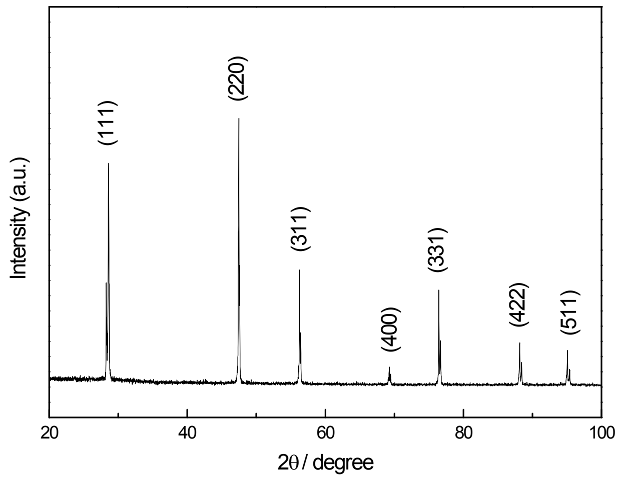


Figure S2. XRD patterns of the raw Si bulk material. It shows the most intensive peak is (220) which is different from the Si NSs products.

Figure S3. The picture of the as-prepared Si NSs by DC arc-discharge method .

The yield is about 40 ml and the weight is about 2.8 g, which was prepared by arc discharge process lasted for 20 minutes. This further verifies that the arc-discharge method can produce the Si NSs in scalable.

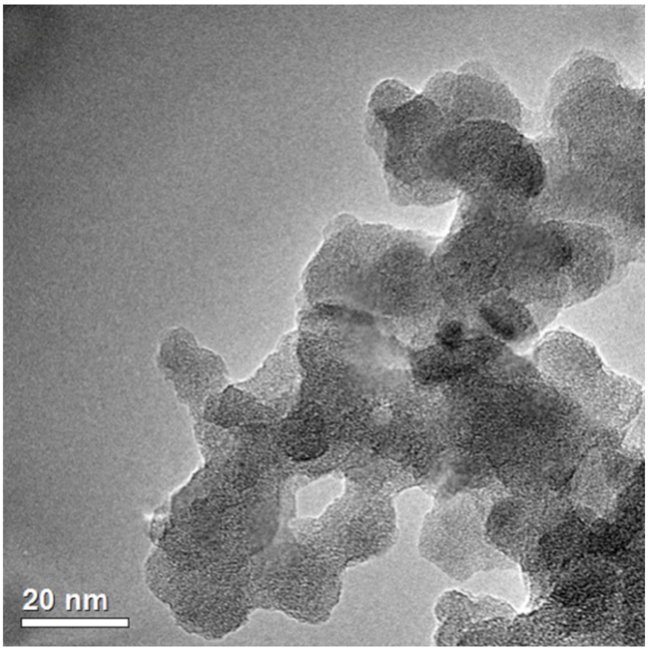


Figure S4. TEM image of Si nanoribbons produced under 0.01 MPa hydrogen-0.05MPa argon condition by DC arc-discharge method.

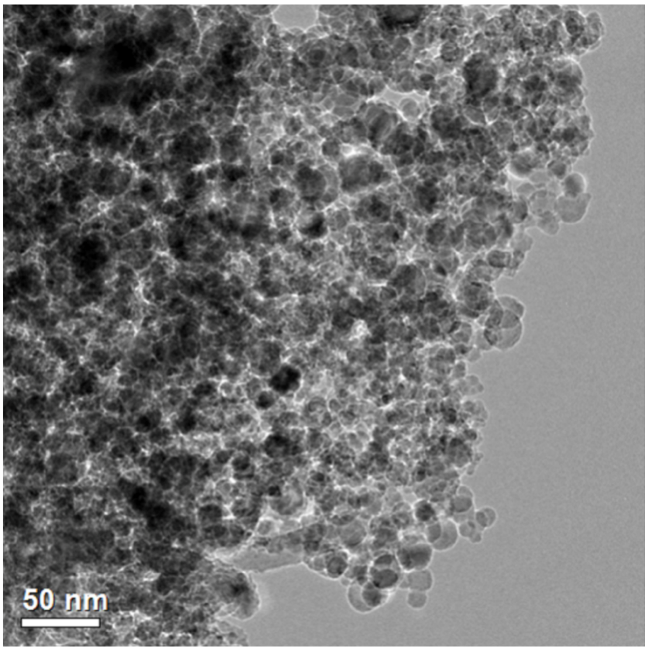
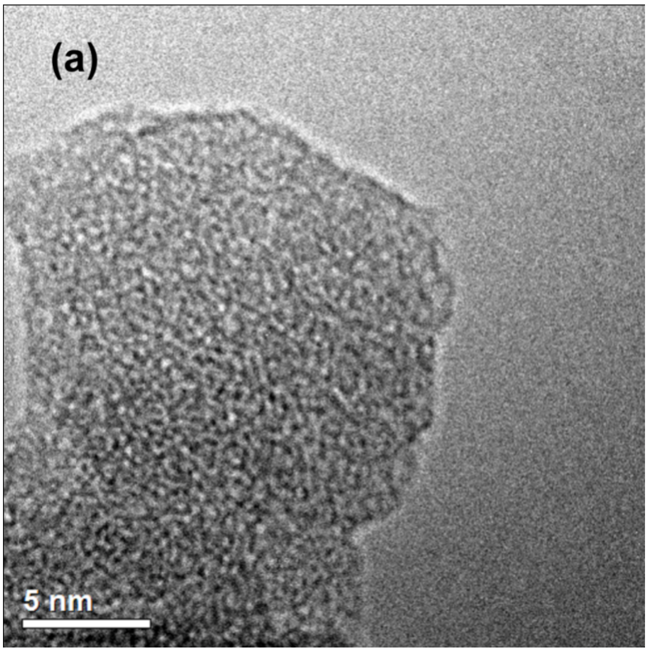
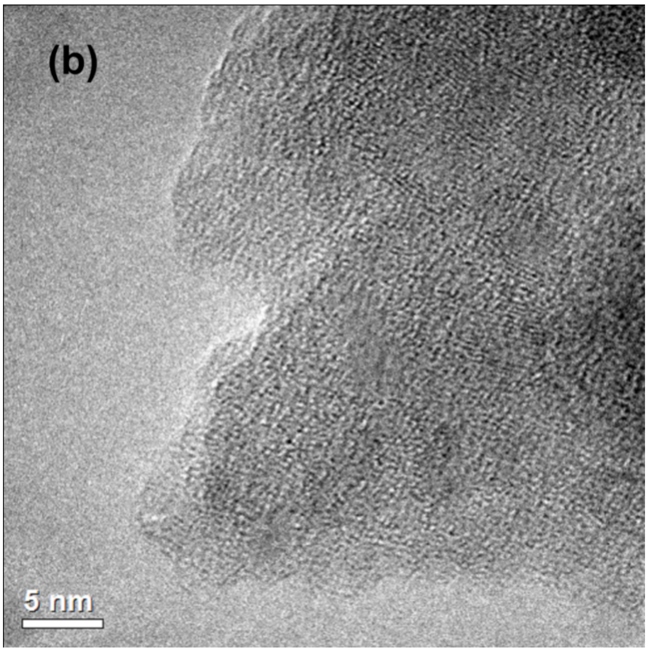


Figure S5. TEM images of Si nanoparticles produced under the conditions of 0.03MPa hydrogen by DC arc-discharge method .


(a)
5 nm


(b)
5 nm

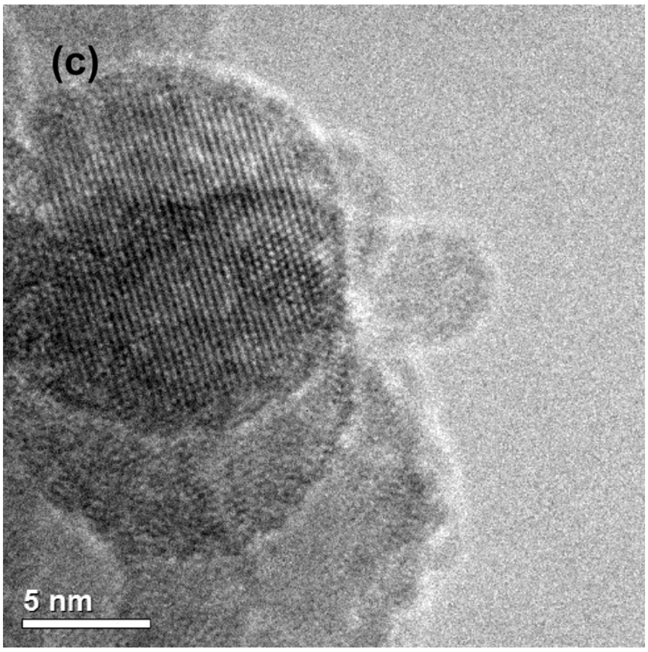


Figure S6. HRTEM image of (a) Si NSs, (b) Si nanoribbons, and (c) Si nanoparticles prepared under the conditions of 0.01 MPa hydrogen-0.02 MPa argon, 0.01 MPa hydrogen-0.05MPa argon and 0.03MPa hydrogen.

Figure S6. shows the HRTEM image of the relevant Si NSs, nanoribbons and nanoparticles. From these HRTEM images, it can be seen that it is failure to acquire the lattice fringe of Si NSs because this kind of material is very thin and only a few atomic layers in thickness. Meanwhile, the lattice fringe of Si nanoribbon become faintly visible and a very clear lattice fringe of Si nanoparticle can be seen since the thickness of these materials increased. The differences in the HRTEM images of different morphologies further indicate the morphology controllable by means of optimizing prepare conditions by DC arc discharge method.

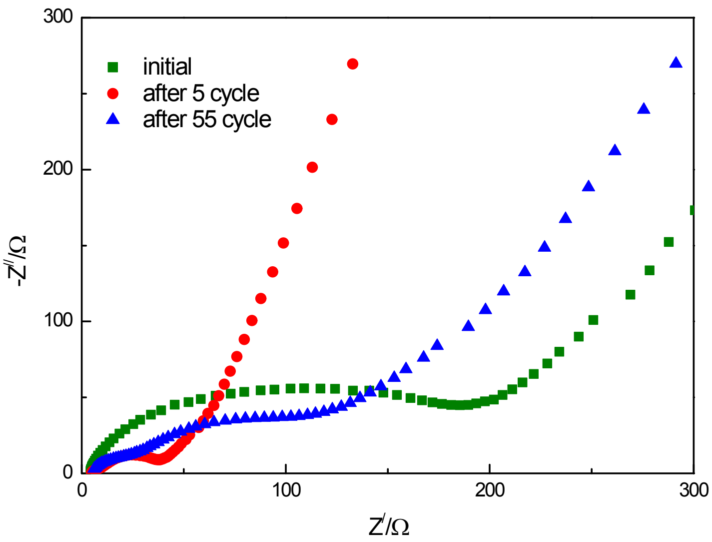


Figure S7. The enlarged Nyquist plots at the high-intermediate frequency for the Si Ns anode before cycling and after 5 and 55 cycles.

From the enlargeed Nyquist plots, it can be seen clearly that there are an additional semicircle appeared at high frequency because of the formation of SEI film after charge-discharge process. Accompanying the cycling process, the volume change of matrix Si leads to the loss electrical contact between active materials and current collector, and SEI films formed on the fresh surfaces, thus results in the increasing of resistance.