Milled-Si@C Composites as Potential Anode Materials for Li-ion Batteries

Hong Lv^{1,*}, Sen Wang¹, Guanghui Zhang¹, Dabin Wang², Wei Zhou¹, Bing Li¹, Minzhe Xue¹, Cunman Zhang^{1,*}

¹ Clean Energy Automotive Engineering Center & School of Automotive Studies, 4800 Caoan Road, Tongji University, Shanghai 201804, China

² Australian Centre for Electromaterials Science, School of Chemistry, Monash University, Clayton, VIC 3800, Australia

*E-mail: lvhong@tongji.edu.cn, zhangcunman@tongji.edu.cn

doi: 10.20964/2019.10.31

Received: 30 May 2019 / Accepted: 29 July 2019 / Published: 30 August 2019

Silicon (Si) has been identified as having high potential for lithium-ion battery anodes because of its ultrahigh capacity. However, its dramatic volume change in the process of lithiation/delithiation and its intrinsically poor electrical conductivity have severely inhibited its practical application. Herein, micron-sized Si alloys with carbon shells are prepared by high-energy ball milling coupled with an evaporation self-assembly method. A high and stable specific capacity of 850.5 mAh/g is achieved over 50 cycles and held at 650 mAh/g after 350 cycles with a coulombic efficiency >99.8%. The highly improved performance could be attributed to the unique microstructure of the as-synthesized composite materials in which crystalline Si nanoparticles are embedded in amorphous Si-M₂O₃ (M = Al and Si) matrix phases with a carbon shell on the surface, thereby achieving better buffering capacity and conductivity. The results we obtained could pave the way for using silicon as anodes for lithium-ion batteries.

Keywords: Silicon, Si@C Composites, Lithium-ion battery, anode, specific capacity

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