

Novel and Pragmatic Approach to Design Silicon Alloy Anode by Equilibrium Method

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Silicon is honored as one of the most promising anode materials for Lithium-ion Batteries (LIBs) because of its high theoretical specific capacity (4200 mAh/g) compared to commercially available graphite anodes (370 mAh/g). Over 20 years, Si has been intensively investigated due to considerable volume expansion of up to 300% upon electrochemical lithiation, leading to electrode cracking and rapid capacity fading. Numerous strategies have been reported with excellent cycle performances in lab-scale [1]. However, up today, many material manufacturers and start-up companies failed to scale-up those technologies for mass-production, in particular, due to the lack of reproducibility, economical feasibility, etc.

Herein, we demonstrate a novel and pragmatic approach for the mass-producible synthesis of Si-alloys with homogeneous microstructure and improved electrochemical performances. Namely, we have designed and optimized amorphous phase Si-alloy composition using reliable and mass-producible melt-spinning process (Fig.1). Further, amorphous alloy is subjected to the thermal annealing process to size-controllable recrystallization and homogeneous growth of nano-Si grains in inactive matrix. As a result of breakthrough strategy the Si-alloy electrode delivered a high specific capacity of 900 mAh/g for 100 cycles at 0.1 A/g with nearly 99% capacity retention [2].

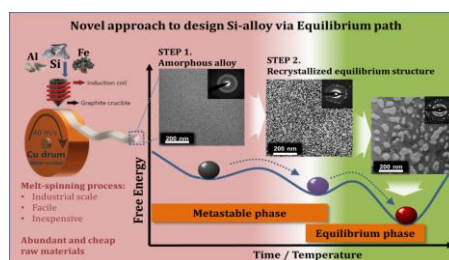


Fig. 1. Schematic illustration of Si-alloy fabrication process [2].

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References

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