Enhanced electrochemical performance of silicon-graphene nanocomposite by high energy ball milling

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Silicon has been promised as alternative anode material for Li ion batteries because its theoretical capacity (4200mAh/g) is over 10 times bigger than graphite (372 mAh/g) and lithium insertion occurs at relatively low potential (< 0.5 V vs. Li/Li+). Although these advantages, silicon has severe problems. The huge volume change (400 %) is occurred when silicon is alloying/dealloying with lithium. This volume change can lead decomposition of electrode and fast capacity fading. To overcome the problems, silicon-graphene composite material were simply prepared by ball milling method. In effect of ball milling, reduction of graphene oxide (GO) to reduced graphene oxide (RGO) without growth of silicon oxide was observed by FT-IR and XRD and, also silicon nanoparticles (SINPs) were anchored onto RGO sheet was also shown in SEM image. Ball mill of GO (14.8 m2/g) and SINP (41.9 m2/g) increases BET surface area to 54.8 m2/g. The cycle performance was much enhanced in comparison with pure SINPs showing first discharge capacity of 3059mAh/g, and a reversible capacity of 1239mAh/g in the 50th cycle at a rate of 300mA/g. Because RGO sheets act as buffer of volume change and lithium active layer which increase lithium diffusivity into SINPs.