High-Performance Silicon/Graphene Composite for Electrochemical Energy Storage

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High energy density and power density of Li-ion batteries have made it an excellent energy storage solution for a wide range of applications. However, to fulfill the ever-increasing demand for energy, long cyclic performance and safety of Li-ion battery, exploring new and more efficient electrode materials has been stressed in recent years. Silicon is considered as the most promising replacement of commonly used graphitic carbon anode material due to very high theoretical Li-storage capacity, earth abundance and better safety aspects. However, severe volume expansion upon lithiation, pulverization from current collector, poor electrical conductivity, unstable solid electrolyte interface layer etc. are the major problems of Si anode. In current report, an attempt is made to address these issues by introducing graphene (Gr) with Si. The Si/Gr composite is engineered in such a way that the electrode possesses porous structure providing Si enough space to expand during Li-intake. Additionally, graphene acts here as strong backbone to Si and provides smooth electronic conduction path so that Si can withstand volume expansion, sustain more lithiation/delithiation cycles and also provide high power density. The thus prepared Si/Gr composite electrodes have shown excellent rate capability and cyclic stability by delivering reversible capacity of ~4000mAh/g at cycling rate of C/5 and 1500mAh/g at a very high cycling rate of 20C with 100% capacity retention even after 50 cycles at such high cycling rates of 20C.