Core-shell Si@Ni nanoparticles encapsulated in carbon nanotubes as high capacity electrode for lithium ion batteries

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Lithium-ion batteries (LIBs) have been broadly applied in portable electronics and electric vehicles in our daily life because it behaves wonderful capacity density and excellent handiness among various energy storage devices. Silicon shows the great advantages of more excellent discharge capacity (4200 mA h g^{-1}) and lower lithiation potential (0.4-0.5 V versus Li/Li^{+}) with the contrast to other anode materials such as graphite, tin, titanium, aluminum, magnesium. But low electronic conductivity and poor property limit Si-based anode materials to commercialize for the LIBs. In order to solve the problems of poor conductivity and cycling instability, core-shell structured Si/Ni nanoparticles encapsulated in carbon nanotubes (Si@Ni-NP@CNT) has been proposed to enhance the electronic conductivity and cycling stability. The nanocomposite was characterized by using the measures of X-ray diffraction and transmission electron microscopy. The Si nano-particles as centre of sphere were coated with interconnected CNTs and nickel-plated layer. The electrochemical performance was tested by cyclic voltammetry and galvanostatic charge-discharge tests. The nanocomposite behaves excellent specific capacity, outstanding cycle stability and perfect rate capability, the results show a reversible charge capacity of 1050 mA h g^{-1} after 50 cycles at a current rate of 100 mA g^{-1}. The enhanced electrochemical performance is due to the core-shell structure, which interconnected CNTs and nickel-plated layer act as buffer compound to avoid the excessive volume expansion and the electrode pulverization.