Carbon Coated Cobalt Sulfide Hollow Nanosphere Anode Materials for Enhanced Performance in Lithium Ion Batteries

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Recently, metal sulfides have attracted great attention due to their high specific capacity [1-7]. Among them, cobalt sulfides possess higher conductivity and thermal stability, compared to other metal sulfides. However, the major issue is the pulverization of electrodes due to the large volume changes upon cycling process, which causes fast decay of the specific capacities. The hollow nanostructure has been reported to relieve the volume expansion and thus improve the cycling performance in other anode materials [8-10]. Here, the carbon coated cobalt sulfide hollow nanospheres with a size of 100-200 nm have been prepared via a facile solvothermal process. The obtained product was characterized by X-ray diffraction, TEM, HRTEM, SAED and electrochemical measurements. The pristine product is mainly amorphous CoS$_2$ phase. However, after heat treatment at 350 °C under Ar/H$_2$ atmosphere, the carbon coated Co$_9$S$_8$ hollow nanospheres can be obtained. When tested as the anode materials firstly, the pristine amorphous CoS$_2$ phase displays poor cycling stability, although the initial discharge and charge capacity is as high as 1584 and 987 mAh g$^{-1}$ at a current density of 100 mA g$^{-1}$. Compared with the pristine amorphous CoS$_2$ phase, the carbon coated Co$_9$S$_8$ hollow nanospheres obtained at 350 °C exhibit better cycling performance and rate capability. The superior electrochemical performance is attributed to the uniform carbon layer, which can restrain the volume changes during cycling.

![Graph](image)

Fig. 1. (a)The Comparative cycling performance of carbon coated Co$_9$S$_8$ hollow nanospheres obtained at 350 °C and pristine amorphous CoS$_2$ at a current density of 100 mA g$^{-1}$ (the inset is the TEM image of as-prepared hollow nanospheres). (b) Rate capability of carbon coated Co$_9$S$_8$ hollow nanospheres obtained at 350 °C and pristine amorphous CoS$_2$ at various current densities.

References


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