The Change of Electrochemical Properties of Li/S Batteries with Discharge Rate

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Introduction

The lithium/sulfur cell was an extremely attractive redox couple because of high theoretical specific energy of 2600Wh/kg(1672mAh/g-sulfur), assuming complete reaction to the Li2S.

The successful development of a lithium sulfur battery requires extensive research on the electrochemical behaviors under various operation conditions.[1,2,3,4,5] Cheon et al. reported that the capacity of Li/S cell decreased with the increasing of current density and thick Li2S layer formed at the surface of the cathode causes the diminution of the second discharge region at high discharge rate by using the scanning electron microscope (SEM).[6]

In this paper, the performance changes of the lithium/sulfur (Li/S) battery with discharge rate are reported. The change of sulfur electrode was tested by scanning electron microscopy (SEM), X-ray diffractometer (XRD), differential scanning calorimeter (DSC) et al. Based on the above analysis results, we tried to find factors that affects the rate capability of the Li/S batteries.

Experiment

Sulfur electrodes were prepared by mixing sulfur, carbon black and PEO powders. The composition of electrode is 70wt% sulfur, 15wt% electric conductor, 15wt% PEO. The slurry is mixed by attrition ball milling for 2h, and then is cast on the Al current collector.

The solution of 0.5M LiCF3SO3 in tetraethylene glycol dimethyl ether (Tetraglyme, TG) was used as an electrolyte.

The configuration of the Li/S cells is Li(350μm thick, Aldrich)/celgard with electrolyte/sulfur electrode. All assemblies of the cells are carried out in argon-filled glove box. Cell tests were conducted under galvanostatic conditions using a WBCS3000 to 1.5V with various discharge rates at room temperature.

In order to investigate the changes of Li/S batteries with discharge rate, we tested by using XRD, DSC, SEM, and Energy Dispersive Spectrometer (EDS).

Results

Figure 1 showed changes of capacities with current densities. The Li/S cell showed above 80% sulfur utilization at very low current density.

Fig. 1. The capacities change of Li/S cells with current densities

References