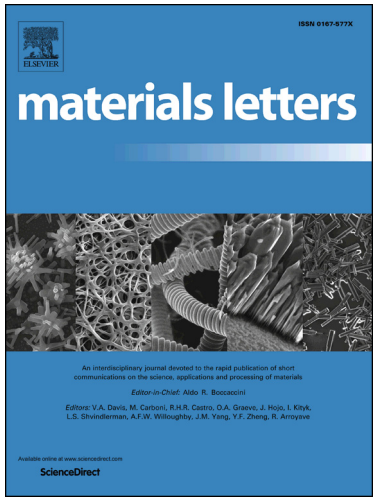

High performance lithium-sulfur batteries with facile titanium nitride particles modified separator

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High performance lithium-sulfur batteries with facile titanium nitride particles modified separator

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Abstract

Rechargeable lithium-sulfur (Li-S) batteries are considered as one of the most potential energy storage devices owing to their high theoretical capacity, environmental friendliness and low cost. However, the practical applications of Li-S batteries are restricted by the low conductivity of sulfur, serious dissolution of intermediate polysulfides and fast capacity degradation. Herein, we design a titanium nitride (TiN) modified separator to improve the long-term cycle stability and discharge capacity of Li-S batteries. Strong interaction between the TiN particles and polysulfides can greatly restrain the "shuttle effect" and benefit the cycle stability. With this modified separator, cathodes with a sulfur loading of 78.1 % could deliver a high initial discharge capacity of 1296 mAh/g and demonstrate a decay rate of 0.17 % per cycle under a high current density of 0.5C. Such superior electrochemical performances ascribe to the high conductivity of TiN and strong affinity between TiN particles and polysulfides.

Key words:

Lithium-sulfur batteries; titanium nitride particles; modified separator; high content sulfur;

1. Introduction

Li-S batteries are very promising rechargeable energy storage systems due to their excellent specific energy density of 2600 W·h/kg, which is much higher than present Lithium-ion batteries [1]. However, their large scale application is limited by low active material utilization and poor cycle life mainly because of the low electronic conductivity of sulfur and the severe shuttling effect of soluble lithium polysulfides (LiPSs) formed in the electrochemical reactions [2]. Previously researches have mainly focused on restraining LiPSs shuttling and increasing the conductivity of cathode by combining porous carbon structure [3], oxides [4], and conductive polymers [5]. However, the employment of these materials can also bring complicated manufacturing processes and reduce the sulfur content in the cathode [6]. Thus, an interlayer, as a novel cell configuration, between the cathode and separator has been put forward, which could effectively increase the utilization of sulfur and improve electrochemical performance [7-9].