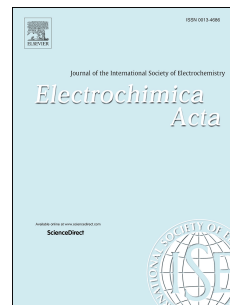


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Improved electrochemical performance of silicon nitride film by hydrogen incorporation for lithium-ion battery anode

X.D. Huang^{*}, X.F. Gan, F. Zhang, Q.A. Huang

Key Laboratory of MEMS of the Ministry of Education, Southeast University, Nanjing 210096, China

J.Z. Yang^{*}

School of Chemistry and Chemical Engineering, Nanjing University of Science and Technology, Nanjing 210094, China

ABSTRACT: Silicon nitride anodes are prepared by inductively-coupled-plasma and plasma-enhanced chemical vapor deposition techniques (denoted as ICP-CVD and PE-CVD respectively). The main difference of the ICP-CVD and PE-CVD anodes is considerable hydrogen content in the latter. The effects of hydrogen incorporation on the anode performance are investigated by comparing the ICP-CVD anode with the PE-CVD one. The capacity of the ICP-CVD anode maintains a low value (39 mAh g⁻¹ for the 500-nm film) with cycling. For comparison, the capacity of the PE-CVD anode is negligible at first but increases abruptly after several cycles. The 500-nm PE-CVD anode delivers a reversible capacity of 881 mAh g⁻¹ over 300 cycles at 0.6 C. A stable capacity of 773 mAh g⁻¹ can still be obtained even when the anode increases to 900 nm. Due to weak strength of the hydrogen-containing bonds in the PE-CVD anode, hydrogen dissociation happens with cycling, which increases the anode conductivity and reaction kinetics, thus resulting in the high capacity. The hydrogen dissociation also leads to the formation of LiSi_xN_y, which has a high ionic conductivity and also can act as a buffer matrix surrounding the active anode, thus helpful to improve the anode performance.

Keywords: Lithium-ion battery; Silicon nitride anode; ICP-CVD; PE-CVD; Hydrogen dissociation.

* Electronic mail: xdhuang@seu.edu.cn, jiazhiyang@sina.com.

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