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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.

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