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**In Situ Catalytic Growth 3D Multi-layers Graphene Sheets Coated Nano-Silicon Anode  
for High Performance Lithium-Ion Batteries**

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**Abstract**

Silicon (Si) has been considered as the next generation ideal anode material for lithium-ion batteries because of its highest theoretical capacity ( $4200\text{mAh}\cdot\text{g}^{-1}$ ) and affluent reserves in nature. However, the severe volume expansion and unstable solid electrolyte interface (SEI) film of Si electrode during lithiation/delithiation, as well as the poor electron conductivity have seriously restricted its commercial application. In this work, in situ catalytic growth graphene on the surface of nano-Si (Si@Graphene) composite is successfully developed through a novel electroless deposition approach with Ni as the catalyst. The as-prepared Si@Graphene composite exhibits excellent cycling stability and rate capability, which retains a reversible discharge capacity up to  $1909\text{mAh}\cdot\text{g}^{-1}$  after 100 cycles at  $0.2\text{A}\cdot\text{g}^{-1}$ , and is able to deliver a discharge capacity of  $975\text{mAh}\cdot\text{g}^{-1}$  even at a high current density of  $5\text{A}$

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