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Interface engineering of few-layered MoS_2 nanosheets with ultrafine TiO_2 nanoparticles for ultrastable Li-ion batteries

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Abstract:

The highly structural integrity of electrode materials before and after cycles has been widely recognized as the pivotal for achieving stable lithium-ion batteries. Herein, an interface-reinforcement strategy has been developed to enhance the structural stability of two-dimentional (2D) nanomaterials. The TiO_2/MoS_2 hybrids are synthesized by anchoring ultrafine TiO_2 nanoparticles on few-layered MoS_2 nanosheets using a facile and scalable method. Such a facinating 0D/2D heterostructure can effectively overcome the shortcoming of MoS_2 nanosheets easy-stacking, promoting the electrolyte accessability to 2D interlayer space. Impressively, the robust Ti-O-S covalent interaction between them can greatly consolidate the 2D nanosheets, alleviating the structural stress change caused by lithiation/delithiation. Consequently, the as-obtained TiO_2/MoS_2 hybrids exhibit a remarkably improved specific capacity compared to the exfoliated MoS_2 nanosheets at various rates. A stable specific capacity of 410 mAh g^{-1} is still maintained even through over 500 cycles at 1.0 A g^{-1}. The interface-reinforcement concept can also be extended to other 2D nanomaterials, showing huge application potential for stable LIBs.

Keywords: Exfoliated MoS_2 nanosheets; TiO_2; interface-reinforcement; high stability; lithium-ion batteries