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Fabrication of Graphene/MoS_2 Alternately Stacked Structure for Enhanced Lithium Storage

Graphene materials have attracted significant research interest as anodes in lithium-ion batteries (LIBs) [1]. However, their low volumetric capacity and high working voltage limit the energy density and thus hinder their practical applications [2]. As an important layered transition metal dichalcogenides, MoS_2, has raised recent research interest due to its unique physicochemical properties. It shows a high reversible capacity of 3385 mAh cm-3 with an insertion voltage of about 2 V vs. Li/Li^+ [3]. Therefore, introducing MoS_2 into a graphene matrix may improve the volumetric capacity of graphene. Fabricating a graphene/MoS_2 heterostructure could bring about new properties for lithium storage due to the strong van der Waals force. Studying the effects of such interlayer action on the lithium storage property could be of great interest and significance [4].In this research, monolayer graphene and MoS_2 were prepared by controlled CVD growth processes. Graphene/MoS_2 alternately stacked structure (GMASS) was subsequently fabricated by alternately stacking graphene and MoS_2 monolayers layer by layer. When evaluated as an anode for LIB, GMASS demonstrates an obviously reduced working voltage compared to monolayer graphene electrodes (1.31 V vs. 1.46 V), and its volumetric capacity is much higher than that of an average graphite anode (1260 mAh cm^{-3} vs. 461 mAh cm^{-3}). This research could promote the development of graphene/MoS_2 heterostructures for high-energy LIBs.

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Figures

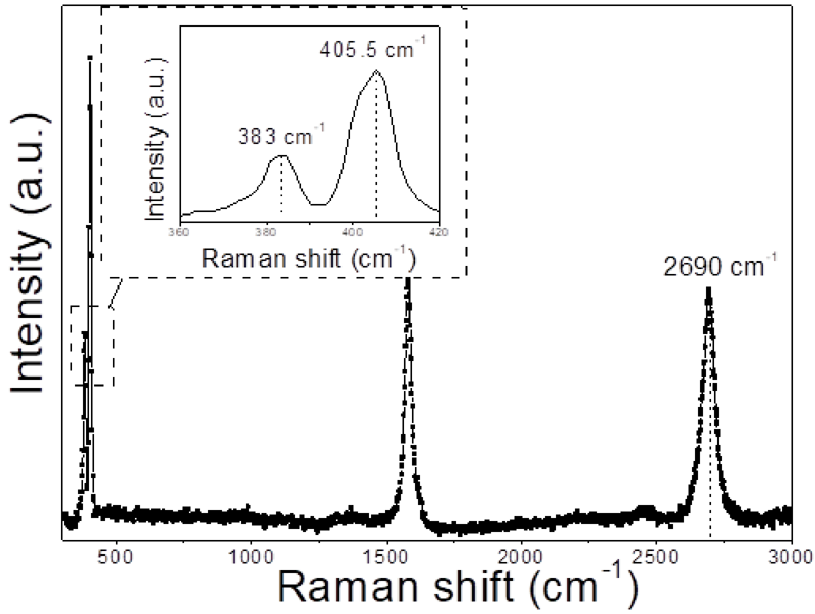

Figure 1: Raman spectrum of GMASS.

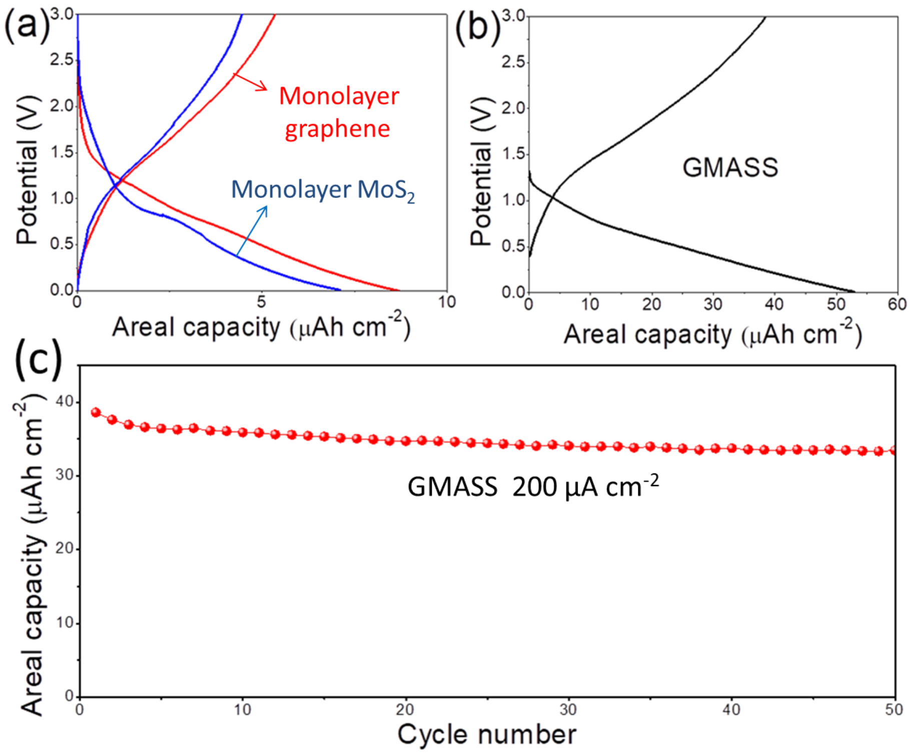

Figure 2: (a) Charge/discharge curves of the monolayer graphene and monolayer MoS2. (b) Charge/discharge curves of GMASS.(c) Cycling stability of GMASS.