Fabrication of single-layer MS$_2$ (M=Mo, W) nanosheets using Li battery setup

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Abstract

Lithium intercalation is a convenient method to prepare few-layer and single-layer MS$_2$ (M=Mo, W) nanosheets. This method is, however, very time-consuming (few days) and it is difficult to control the reaction parameters. To overcome these drawbacks, we have proposed a method to use an Li battery set-up to significantly reduce the reaction time (few hours) and electrochemically intercalate lithium ions into MS$_2$ layers in a controllable manner. Atomic force microscopy (AFM), scanning electron microscopy (SEM) and Raman spectroscopy results revealed that MoS$_2$ and WS$_2$ single-layer (thickness of ~ 1 nm) nanosheets with the 1T phase were prepared after intercalation in an Li battery set-up. Lateral dimensions of MoS$_2$ and WS$_2$ nanosheets were determined to be at about ~ 170 ± 15 and 200 ± 30 nm, respectively. The concentrations of the final solutions containing MoS$_2$ and WS$_2$ nanosheets were measured to be 0.012 and 0.008 mg/mL, respectively. Successful fabrication of the single-layer MS$_2$ nanosheets using the Li battery set-up could provide an excellent opportunity to investigate the unique properties of these two-dimensional crystals for various important applications such as catalysis, solar cells, optoelectronic, etc.

Keywords: electrochemical intercalation, Li battery setup, single-layer, MoS$_2$, WS$_2$

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