Electrochemically exfoliated $NbSe_2$ nanosheets and nanorolls for high capacity lithium storage

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Metallic $NbSe_2$ in two-dimensional (2D) and other nanostructured forms is a potentially attractive material for electrochemical energy storage (EES), but has been much less explored than other members of the transition metal dichalcogenide (TMD) family (e.g., MoS_2, WS_2 or $MoSe_2$) [1]. Here, the lack of targeted methods to produce 2D $NbSe_2$ with useful nanomorphologies that can, e.g., alleviate the typical re-stacking issues during electrode processing constitutes a barrier to its application in EES. This work presents a rapid and direct method to prepare $NbSe_2$ nanosheets and nanorolls, as well as other 2D TMDs, by an uncommon electrochemical exfoliation route carried out in aqueous medium with a simple salt as the electrolyte. The cathodic process can be completed using bulk $NbSe_2$ powder in a few minutes with significant yields of exfoliated product (~16 wt %). Further, the dominant morphology of the resulting delaminted material can be tuned between rolled nanosheets (nanorolls) and unfolded nanosheets depending on the solvent in which the nanoobjects are subsequently dispersed (water and isopropanol, respectively). The electrochemical delamination mechanism was investigated and concluded to involve a chemical redox process triggered by the cathodic treatment. The exfoliated $NbSe_2$ material with nanoroll morphology exhibited a high lithium storage capacity, reaching values up to 750-800 mAh g^{-1}, with the effect of the nanoroll morphology associated to increased accessibility of its lithium storage sites [2]. In summary, by implementing a straightforward method of low environmental impact for the production of 2D TMDs, the present work is expected to expand their availability for targeted applications.

References

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Figures

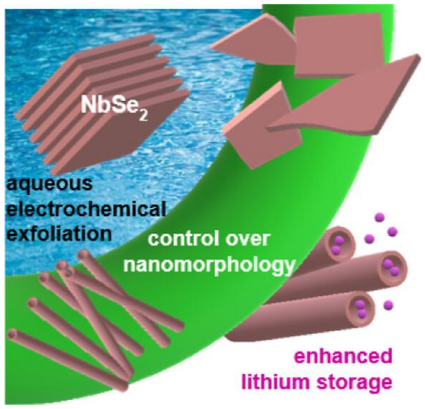

Figure 1: Scheme for obtaining 2D materials of different morphology and their application in lithium storage devices