High quality and Solution-Processable MoS_2 Nanosheets Obtained by Electrochemical Exfoliation for Energy Storage and Catalytic Applications

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The production of MoS_2 nanosheets by electrochemical exfoliation routes holds great promise as a means to access this two-dimensional material in large quantities for different practical applications [1]. Here, we introduce a safe and sustainable method for the cathodic delamination of MoS_2 that makes use of aqueous solutions of very simple and widely available salts, mainly KCl, as the electrolyte [2] (Figures 1 and 2). Combined with an appropriate biomolecule-based solvent transfer protocol, such an electrolytic exfoliation route is shown to afford colloidally dispersed, oxide-free and phase-preserved MoS_2 nanosheets of a high structural quality (Figure 3) in considerable yields. An asymmetric supercapacitor assembled with a cathodic MoS_2 nanosheet-single walled carbon nanotube hybrid as the positive electrode and activated carbon as the negative electrode delivered energy densities (e.g., 26 W h kg^{-1} at 750 W kg^{-1} in 6 M KOH) that were competitive with those of other MoS_2-based asymmetric devices (Figure 4). When used as a catalyst for the reduction of nitroarenes, the present cathodically exfoliated nanosheets exhibited one of the highest activities reported so far with MoS_2 nanostructures, the origin of which is accounted for as well [2]. Overall, by facilitating access to this two-dimensional material through a particularly simple, efficient and cost-effective technique, these results should expedite the practical implementation of MoS_2 nanosheets in energy, catalysis and beyond.

References

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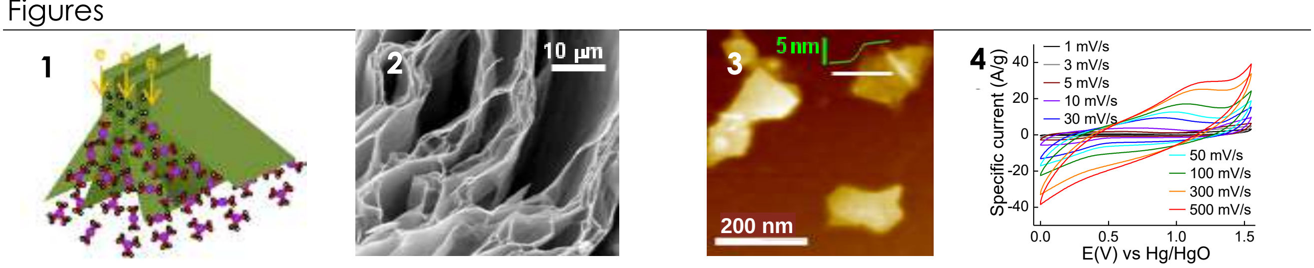
Figures



1 Schematic illustration of the cathodic delamination of MoS_2 in aqueous alkali-metal-based electrolytes. **2** Representative FE-SEM image of the cathodically expanded MoS_2 piece. **3** Typical AFM image of MoS_2 nanosheets deposited onto a mica substrate from their dispersion. A representative line profile (green line) taken along the marked white line is shown overlaid on the image. **4** Cyclic voltammograms recorded for the asymmetric two-electrode cell at different potential scan rates.