MoS_2 and WS2 Heterostructures Synthesized in Graphene Oxide at Ambient Conditions

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Abstract. In a previous work [1], we introduced a simple chemical synthesis of 2D metal iodides (2D-MI) embedded between graphene sheets where the desired 2D-MI is formed in graphene oxide at ambient conditions. Recently we succeeded to extend the method to synthesize 2D transition metal dichalcogenide, MoS_2 and WS_2, encapsulated in graphene. Similar to the previous synthesis conditions, these chemical reactions also run under ambient conditions. In this work, flakes of single-layer MoS_2 and WS_2 embedded between graphene sheets were widely characterised by Raman and electron energy loss spectroscopy, confirming presence of WS_2 or MoS_2 with reduced graphene oxide, whereas scanning transmission electron microscopy images show a dense appearance of single layer crystals of WS_2 or MoS_2 separated by graphene. The results of electrical conductivity measured in the temperature range from 4.2 up to 340 K indicate that the electronic transport is mediated through graphene flakes percolated network, significantly doped by 2D crystals of MoS_2 and WS_2. We also observe negative magneto-resistance at low temperatures typical for weak localization mechanism in disordered systems.

REFERENCE

[1] Mustonen, K. *et al*., Advanced Materials 2106922 (2022)