Structural Characterization of 2D materials in the SEM using EDS and EBSD

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2D Materials enable exciting new applications in electronic devices and show great promise to replace traditional silicon technology as functional building blocks. However, in order to realise this potential there is a range of fabrication and integration challenges that have to be overcome and suitable characterisation techniques are needed. Due to their high resolution, electron optical characterisation in scanning electron microscopes (SEMs) and transmission electron microscopes (TEMs) is ideally suited for the structural characterisation of devices incorporating 2D materials. However, while electron imaging can give important insights into the device structure, for a full structural characterisation additional compositional data obtained from EDS analysis and crystallographic data from EBSD analysis can be added.

Here we show how by processing EDS data obtained using highly sensitive, new generation EDS detectors in specially adapted software we can obtain data of sufficiently high quality to non-destructively measure the number of layers in 2D MoS_2 (fig. 1) and thereby enable the characterisation of working devices based on 2D materials. We also show how we can use EBSD to address fabrication challenges of 2D materials. Results from EBSD analysis of individual flakes of exfoliated MoS_2 obtained using the are shown to aid a better understanding of the exfoliation process which is widely used to produce 2D materials for research purposes. We show how EBSD can be used to detect the misorientation between flakes originating from different transfers (fig. 2).

Figures

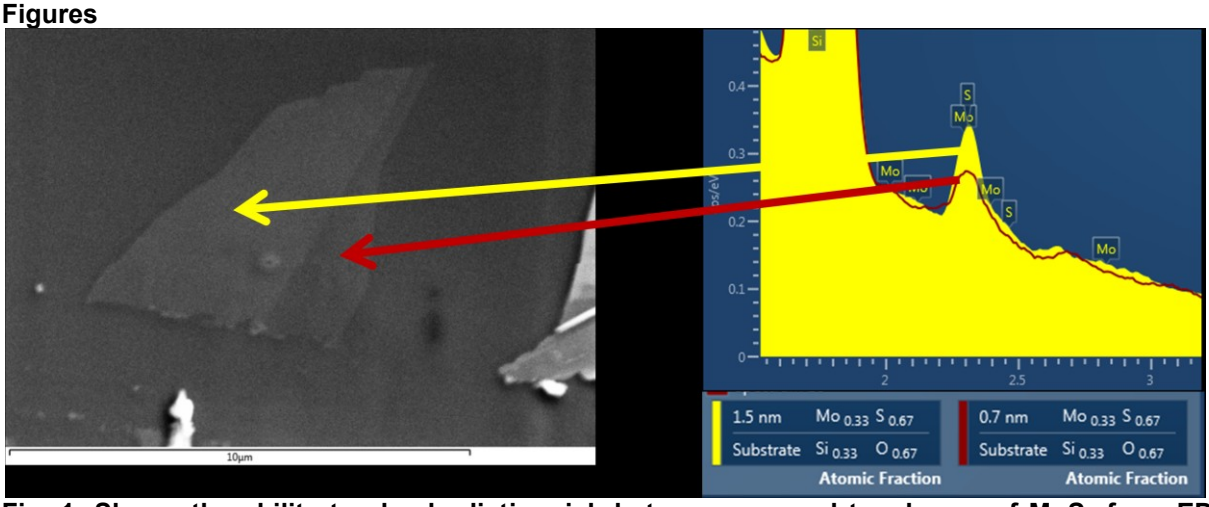

Fig. 1: Shows the ability to clearly distinguish between one and two layers of MoS_2 from EDS spectra

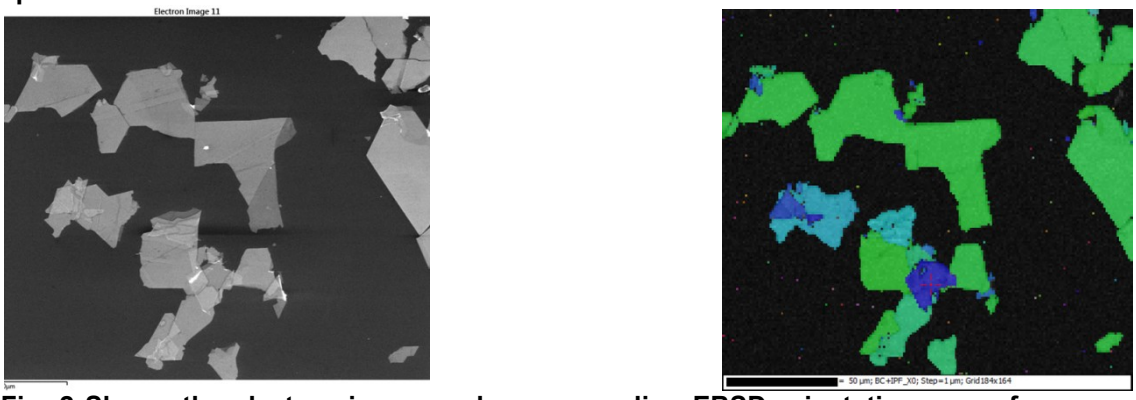

Fig. 2 Shows the electron image and corresponding EBSD orientation map of an assembly of MoS_2 flakes