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Measurements of Fermi Level and Doping Concentration of 2D Transition Metal Dichalcogenide Using Kelvin Probe Force Microscopy

Some of atomically thin two-dimensional (2D) materials show good electrical performances. Many of the interesting electrical properties can be realized more diversely by controlling dopant concentration. In this work, we used plasma techniques to control the Fermi level of 2D transition metal dichalcogenide (TMDC), which can be strongly related to dopant concentration (or it can be understood as carrier concentration many cases). As 2D TMDC, we found that semiconducting WSe_2 and $MoTe_2$ were effectively doped as p-type, attributed to surface oxidation induced by N_2 and O_2 plasma. To make the quantitative analysis of the plasma doping effects, the Kelvin probe force microscopy (KPFM) was employed in this work and we confirmed the Fermi level shifts, strongly related to the doping concentrations of 2D TMDC. The validity of the KPFM results were confirmed by measuring electrical characteristics of FET devices fabricated from the 2D TMDC.

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