Interaction between 2D transition metal dichalcogenides and metal atoms for use in electrical contacting, investigated via atomic resolution HAADF Scanning Transition Electron Microscopy

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Effective contacting of 2D materials will be vital in these materials available for industrial applications, especially for the electronics industry. 2D forms of transition metal dichalcogenides (TMDCs) are attractive for electronics due to their bandgap characteristics. However, unless we find a stable electrical contacting solution, use of these 2Ds by the electronics industry will be unattainable.
DFT calculations and theoretical studies from multiple sources have suggested various metals that might form favourable contacts with TMDCs [1]. Researchers have used AFM and Raman spectroscopy to characterize metals when grown or transferred to thin films [2]. However, there is sparse experimental evidence of the detailed interaction, i.e., on the atomic level.

We investigated distribution and characteristics of various metals, such as gold, molybdenum, palladium etc., on few-layer transition metal dichalcogenides using atomic resolution high angle annular dark field (HAADF) imaging. I physically exfoliated TMDCs such as MoS2 and WS2 to create thin, few-layer areas. Sputtering of angstrom quantities of metals on the flakes allowed for interaction of the metal and TMDC to be investigated on the sub-Å scale in an aberration-corrected transmission electron microscope. Low energy sputtering of the metal introduced the metals to the 2D materials without causing damage to the thin flakes. We compared this experimental data to simulated HAADF images, to confirm and better understand the metal-2D interaction and interfacing.

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