Graphene as an ideal surface to measure STM force interaction

Richard Cobley

Swansea University, UK

When a scanning tunnelling microscope (STM) tip is moved towards suspended or supported graphene, attractive forces cause the graphene membrane to deflect discontinuously up to the tip. By manipulating the probe height, local ripples can be induced in the graphene, the number of layers in few-layer graphene can be counted, and the local resistance through the ripple can be selectively modified.

By modelling the forces between the probes and graphene, the hysteretic deflection response can also be used to understand the STM force interaction. For few-layer graphene the interaction is found to be a combination of both short range van der Waals and long range electrostatic forces acting on the graphene. A complex voltage-dependent interplay produces unexpected results where, for example, increasing the tip voltage can reduce the maximum out-of-plane extension of the graphene, both in measurement and simulation.

Unpublished results on single layer CVD graphene will show the voltage dependence has an even more pronounced boundary between low- and high-voltage deflection behaviour, suggesting that single layer graphene could be an ideal surface to characterise the forces exerted during STM investigation.

Using multiple tips to measure STM-induced oscillation, and future work using simultaneous qPlus AFM/STM will also be discussed.