Strain Superlattices in Stepped graphene

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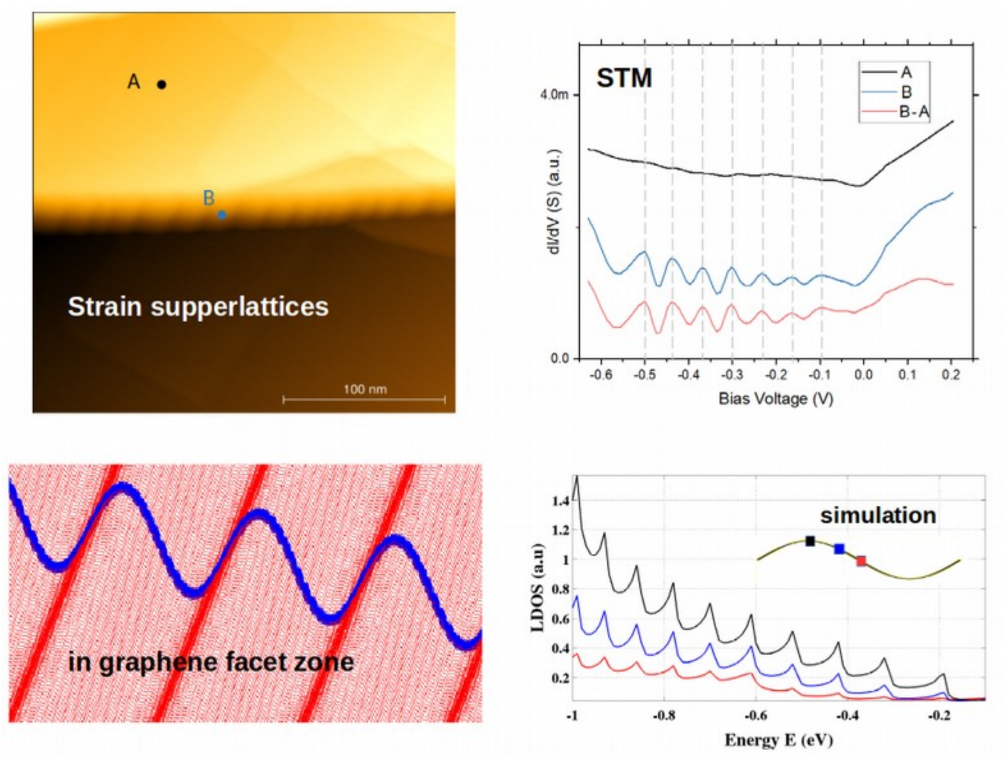
Tailoring electronic properties of two-dimensional (2D) materials, e.g., by merging different materials to form either lateral or van der Waals heterostructures, has recently been a timely research topic. In the current work [1], we demonstrate a novel technique of engineering electronic properties in 2D materials by periodically strain modulating their lattice. Akin to a plastic wrap pulled taut at its edges, graphene under extreme (>10%) strain forms nanoscale ripples when the sheet is draped over Copper step substrates. Within these ripples, carbon-carbon bond lengths vary, creating alternatively dense and rare regions that represent different electronic couplings between atoms, similar to lateral heterosystems of two different materials. Thus, a single graphene sheet effectively becomes an electronic superlattice in which novel electronic states arise at the interfaces. Combining scanning tunneling microscopy and atomistic calculations, we find that these electronic states are driven by intense interfacial pseudo-gauge (i.e. pseudo-magnetic and electric) fields in the order of 100 T and 10^7 V/m. Such a technique of manipulating electronic states can be helpful to realize longstanding theoretical proposals, such as valley filters, snake states and electron optics in graphene and other 2D materials.

References

[1] R. Banerjee *et al.*, arXiv:1903.10468 (2019)

Figures



Strain Superlattices by draping Graphene over Copper step edges.