Observing various Moiré pattern on two-dimensional (2D) materials by advanced Atomic Force Microscopy (AFM) based imaging techniques

Chris Jung
Park Systems Corp. South Korea

The observation of moiré patterns in two-dimensional (2D) materials has become a focal point in materials science due to the unique electronic and mechanical properties these patterns can induce. Advanced Atomic Force Microscopy (AFM) based imaging techniques, including Conductive AFM (C-AFM), Piezoresponse Force Microscopy (PFM), Lateral Force Microscopy (LFM), and Torsional Resonance Mode AFM (TFM), provide high-resolution insights into these moiré patterns. These techniques enable the detailed characterization of surface topography, electronic properties, and mechanical behavior at the nanoscale. By utilizing these advanced AFM methods, researchers can visualize and manipulate the moiré superlattices formed in 2D heterostructures, such as graphene on hexagonal boron nitride (hBN) or transition metal dichalcogenides (TMDs). The findings reveal that the moiré patterns significantly influence the local electronic states, leading to phenomena such as flat bands and correlated insulating states. This research not only enhances our understanding of 2D materials but also opens up new possibilities for designing novel electronic devices with tailored properties