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It's Not A Bug, It's A Feature: Defects in (Moiré) 2D Polymer Bilayers

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Abstract:

A 2D moiré superlattice forms when two or more atomically thin layers, such as graphene or transition metal dichalcogenides (TMDs), are stacked with a slight twist or lattice mismatch. This results in a moiré pattern with a periodicity much larger than the original lattice constants, giving rise to novel quantum properties. Moiré superlattices have revealed a range of exotic quantum phenomena, including flat electronic bands, the anomalous quantum Hall effect, unconventional superconductivity, and ferromagnetism. These discoveries underscore their transformative potential for future quantum technologies, as they provide a tunable platform bridging superconducting and insulating states.

Despite significant scientific progress, a major challenge remains: the lack of a general and efficient method for producing high-quality 2D moiré materials. In my talk, I will explore the potential of synthetic 2D polymer bilayers, created via on-surface synthesis, as alternatives to graphene- or TMD-based moiré superlattices. I will first discuss how on-surface synthesis, combined with scanning tunneling microscopy (STM), enables the characterization of the structural and dynamic properties of synthetic 2D polymers. Finally, I will present our recent findings on the formation of moiré superlattices in synthetic 2D polymers, especially the formation of defects within such moiré bilayers.

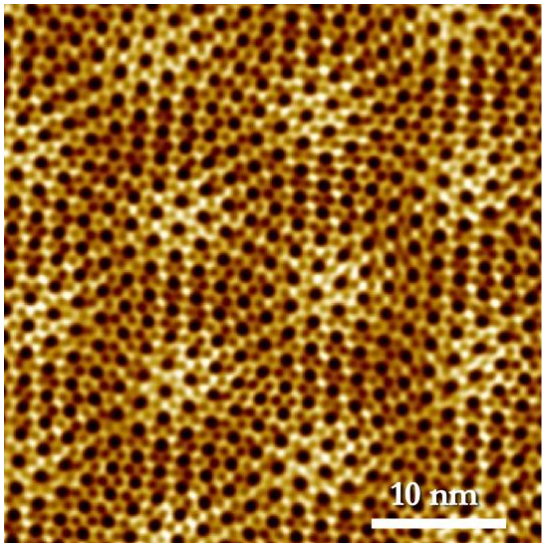

Figure 1. A moiré superlattice formed by a synthetic 2D-polymer bilayer

References:

1. ACS Nano **2020,** *14,* 2354–2365
2. Nature **2022,** *603,* 835–840
3. Nature Chem. **2025,** *17,* 518–524