Moiré-Tile Manipulation-Induced Friction Switch of Graphene on a Platinum Surface

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Friction control and technological advancement are intimately intertwined. Concomitantly, two-dimensional materials occupy a unique position for realizing quasi-frictionless contacts. However, the question arises of how to tune superlubric sliding. Drawing inspiration from twistronics, we propose to control superlubricity via moiré patterning. Friction force microscopy and molecular dynamics simulations unequivocally demonstrate a transition from a superlubric to dissipative sliding regime for different twist angles of graphene moirés on a Pt(111) surface triggered by the normal force. This follows from a novel mechanism at superlattice level where, beyond a critical load, moiré tiles are manipulated in a highly dissipative shear process connected to the twist angle. Importantly, the atomic detail of the dissipation associated with the moiré tile manipulationγ2;i.e., enduring forced registry beyond a critical normal loadγ2;allows the bridging of disparate sliding regimes in a reversible manner, thus paving the road for a subtly intrinsic control of superlubricity.
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