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Tracking the exact vertical movement of freestanding graphene[1]
PIJUSH GHOSH, JOSH THOMPSON, PAUL THIBADO, University of Arkansas, MEHDI NEEK-AMAL, FRANCOIS PEETERS, Universiteit Antwerpen — Intrinsic ripples in freestanding graphene have, unsurprisingly, been exceedingly difficult to study with common experimental methods. In notable breakthroughs, individual ripple geometry was recently imaged using transmission electron microscopy as well as scanning tunneling microscopy, but these measurements are thus far limited to static graphene configurations. Thermally-activated flexural phonon modes could generate dynamic changes in curvature which would be of great interest to observe. Here, we present how to track the exact vertical movement of a one-square-angstrom region of freestanding graphene using scanning tunneling microscopy. This allows a direct measurement of the out-of-plane time trajectory and fluctuations at one point in space over long periods of time. Based on these data, we also present a model from elasticity theory to explain the unusual very-low frequency oscillations that are observed. Unexpectedly, we sometimes detect a sudden colossal jump, which we interpret as due to mirror buckling. This innovative technique provides a much needed atomic-scale probe for the time-dependent behaviors of intrinsic ripples in freestanding graphene.

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