

Supplementary Information for

Direct Imaging, Three-dimensional Interaction Spectroscopy, and Friction

Anisotropy of Atomic-scale Ripples on MoS₂

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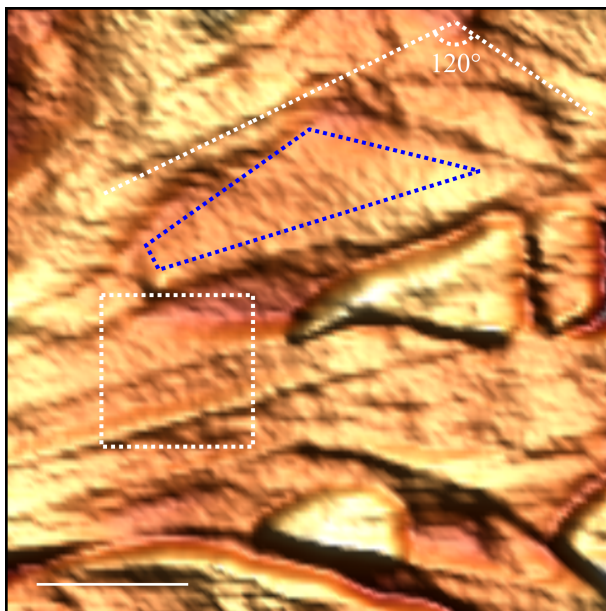
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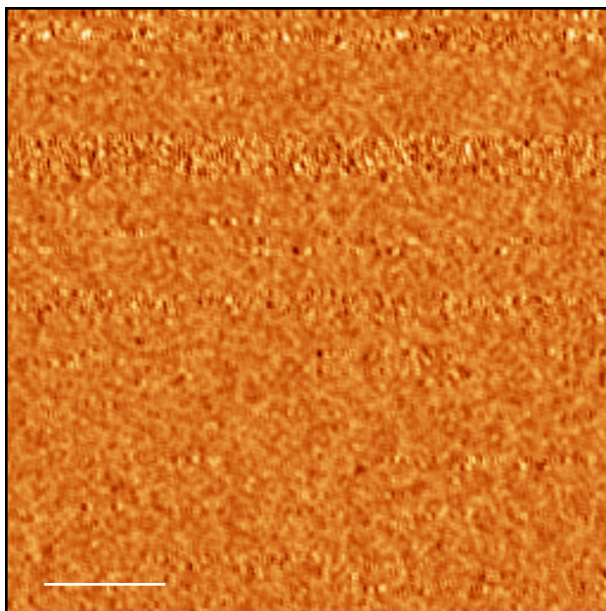
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Supplementary Figure 1. Distribution of Ripples

Supplementary Figure 2. Energy Dissipation



Supplementary Figure 1 | Distribution of Ripples. A large-scale (1,000 nm × 1,000 nm) topographical image (in isometric, pseudo-3D form; color scale range: 4.2 nm) of the MoS₂ flake acquired via high-resolution FM-AFM, including the region with linearly aligned ripples investigated in Figs. 1c and 2 (dashed white rectangle), a representative region where there are no discernible ripples (area highlighted with the blue dashed lines) and a ripple that changes direction by ~120° (dashed white lines), in accordance with the atomic symmetry of MoS₂. Scale bar: 250 nm.



Supplementary Figure 2 | Energy Dissipation. A map (250 nm $\times$ 250 nm) of energy dissipation recorded simultaneously with the high-resolution topographical image of Fig. 1c (color scale range: 1.8 meV). The lack of contrast demonstrates that the ripples observed in the topography map are indeed inherent structural features and not clusters formed by adsorbates from the environment. Scale bar: 50 nm.