

Supplementary Information for “Direct observation of Molecules in Asteroid Ryugu Reveled by High-Resolution Atomic Force Microscope”

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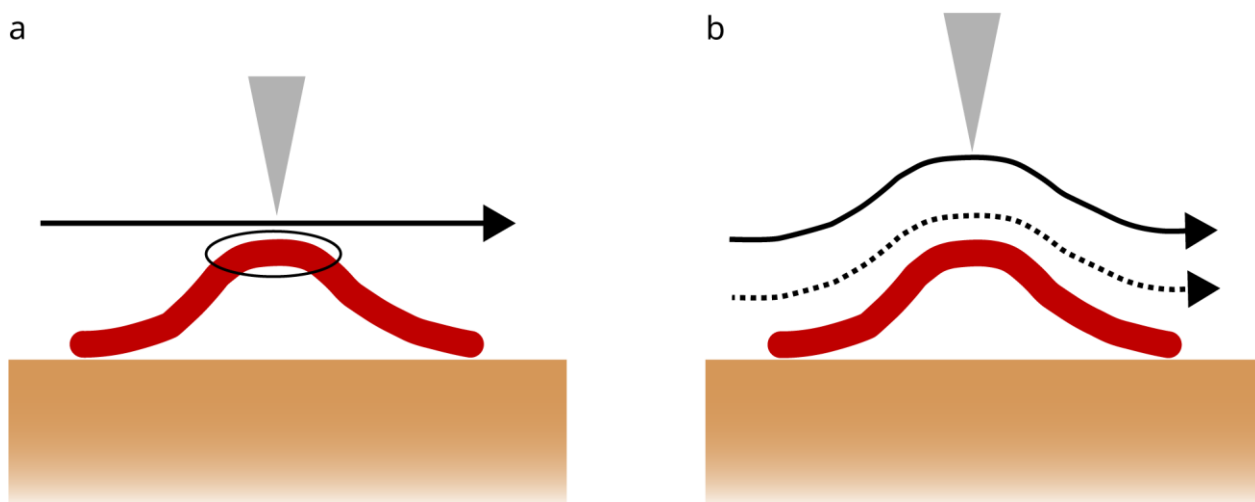
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Supplementary Fig. 1 | Schematic illustrations of high-resolution AFM imaging. a. Constant-height mode and **b.** multi-pass mode is schematically illustrated. The thick red lines, grey triangles, and solid and dotted black arrows represent a three-dimensional molecule adsorbed on the substrate, the AFM tips, and their scan trajectories, respectively. In the constant-height mode, the tip scans parallel to the substrate at the fixed tip height, as shown by the arrow. Only the protruding part of the molecule (indicated by a circle) is imaged, because the tip can approach close enough to detect the repulsive force responsible for the high-resolution imaging. In contrast, the tip is difficult to reach the repulsive region over the lower part of the molecule without crashing higher part. In the multi-pass mode, the first scan (solid arrow) is performed with STM feedback control active. Then the second scan (dotted arrow) follows the trajectory of the first scan but with an offset tip height. This mode allows the tip to get close enough to probe the repulsive force even over the lower part of the corrugated molecules.