Atomic Imaging with Peak Force Tapping

B. Pittenger, Y. Hu, S. Lesko, J. Kindt, C. Su, and S.C. Minne

Bruker AFM
112 Robin Hill Road
Santa Barbra, CA 93110
steve.minne@bruker-nano.com

As its name implies, Atomic Force Microscopy (AFM) has long been used to acquire images at the atomic scale. However these images usually only show the lattice of atoms in the crystal and do not show individual atomic defects. In order to achieve atomic resolution, researchers have typically had to design their systems for the ultimate in noise performance, sacrificing ease of use, flexibility, and scan size. Recently we have demonstrated that, by using Peak Force Tapping, our large sample platforms (Dimension Icon, Dimension FastScan) are capable of obtaining atomic resolution imaging along with maps of the tip-sample interaction.

Unlike standard TappingMode, or FM-AFM, Peak Force Tapping uses instantaneous force control, allowing the system to be insensitive to long range forces while maintaining piconewton level control of the force at the point in the tapping cycle that provides the highest resolution – the peak force. Since the modulation frequency is far from resonance, the technique is less sensitive to the cantilever thermal noise (Brownian motion). In addition to topography, this technique can provide maps of the interaction between the tip and the sample. This is possible since Peak Force Tapping has access to the instantaneous force between tip and sample at any point in the modulation cycle. To study the details of a tip-sample interaction, Atomic Peak Force Capture can acquire the entire force distance curve used to create the interaction maps (Figure 1). These curves can be exported for easy analysis with models of tip-sample interaction.

In this talk we will discuss the latest atomic resolution results using Peak Force Tapping and the implications of this with regard to studies of dissolution, crystallization, ordered liquids, and corrosion.

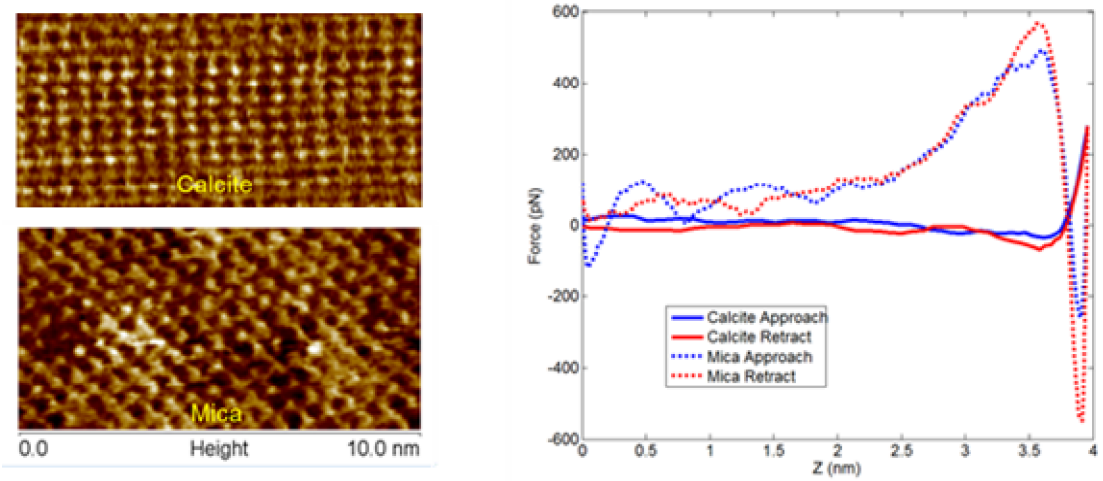

Figure 1: Force distance curves from two different systems (mica, calcite) collected with Atomic Peak Force Capture. The mica curves indicate a long range repulsion, perhaps from ordered water near the mica surface, or an electrostatic double layer.