Introduction to Scanning Probe Microscopy (SPM)

ADDITIONAL SPM Methods

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LATERAL (Frictional) FORCE MICROSCOPY

Lateral Force Microscopy (LFM) is conducted when imaging in the contact mode. During scanning in contact mode the cantilever bends not only along vertically to the surface as a result of repulsive Van der Waals interactions, but the cantilever also undergoes torsional (lateral) deformation. LFM measures the torsional bending (or twisting) of the cantilever, which is dependent on a frictional force acting on tip. As a result, this method is also known as friction force microscopy (FFM).

LFM is sensitive to chemical composition or structure of the surface. This imaging mode offers nanometer-scale resolution with sensitivity to variations in surface composition, molecular organization, mechanical properties, and acid-base characteristics.[1-4]

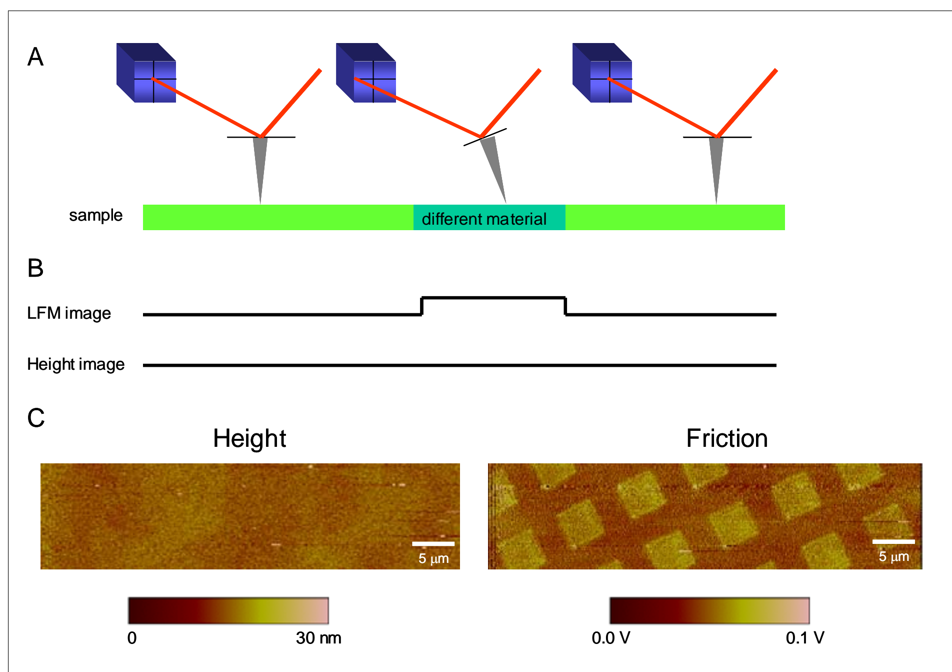

Figure 1. Example of Laterial (friction) force microscopy. A) Torsional bending of the cantilever in response to a sample surface composed of two different materials B) The LFM and height profiles of the surface, show that the height is uniform across the scan, but the LFM indicated an area of higher friction. C) Height and friction analysis of a patterened surface showing areas of varying friction. The friction shows a self assembled monolayer pattern of hexadecanethiol (lower friction-lines) and mercaptohexadecanoic acid (higher friction-squares).

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Note: For LFM imaging, the direction of scanning should be perpendicular to long axis of the cantilever. Furthermore, the roughness of the surface makes interpretation of LFM mapping difficult, as height topography in addition to friction will cause lateral twisting of the cantilever. Therefore, LFM analysis is typically completed on smooth surfaces.

Online Images:
Excellent source for images using phase, CFM and friction contrast.
NIST Building and Fire Research Laboratory Image Gallery
http://www.bfrl.nist.gov/nanoscience/

References:

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