Lecture-8. Microscopy. MRFM

MRFM is not only a mouthful to say (Magnetic Resonance Force Microscopy), it's a brand-spanking-new technique that takes advantage of the atomic-level vibration going on in just about everything. Still under development at the time of this writing (but worth watching), MRFM uses equipment similar to an AFM, with an important difference: The tip is made of magnetic material, and a special coil in the instrument applies a radio-frequency (RF) magnetic field.

Applying the RF field generated by the coil changes a quality called "spin" in the protons and electrons of the sample — flipping that quality back and forth. Each flip changes the magnetic field generated by the atoms in the sample — and the magnetic tip of the MRFM instrument moves in response. Result: the tip and the cantilever vibrate, which deflects a laser beam pointed at the sample. Using that deflection, the microscope detects the vibration and produces a picture of the atoms in the sample. The microscope used in MRFM can vary the frequency of the coil's RF field. By mapping the location of atoms that respond to particular frequencies, you can (theoretically, anyway) find the precise location of specific types of atoms in a sample, which gives you (for starters) a fine-tuned sense of the sample's composition — at the atomic level. Why are people so excited about MRFM? Because MRFM has a high resolution, can go beneath the surface of a sample, and (at least theoretically) can show atomic-scale 3-D images. Reason enough to get excited, we'd say — especially if you're doing nanotechnology research and development. MRFM can be used in materials enhancement, physics, chemistry, biology, and medicine. Because of its high resolution and pinpoint accuracy, that may be just the beginning.

PhD, Утегенов Алмасбек Улубекович