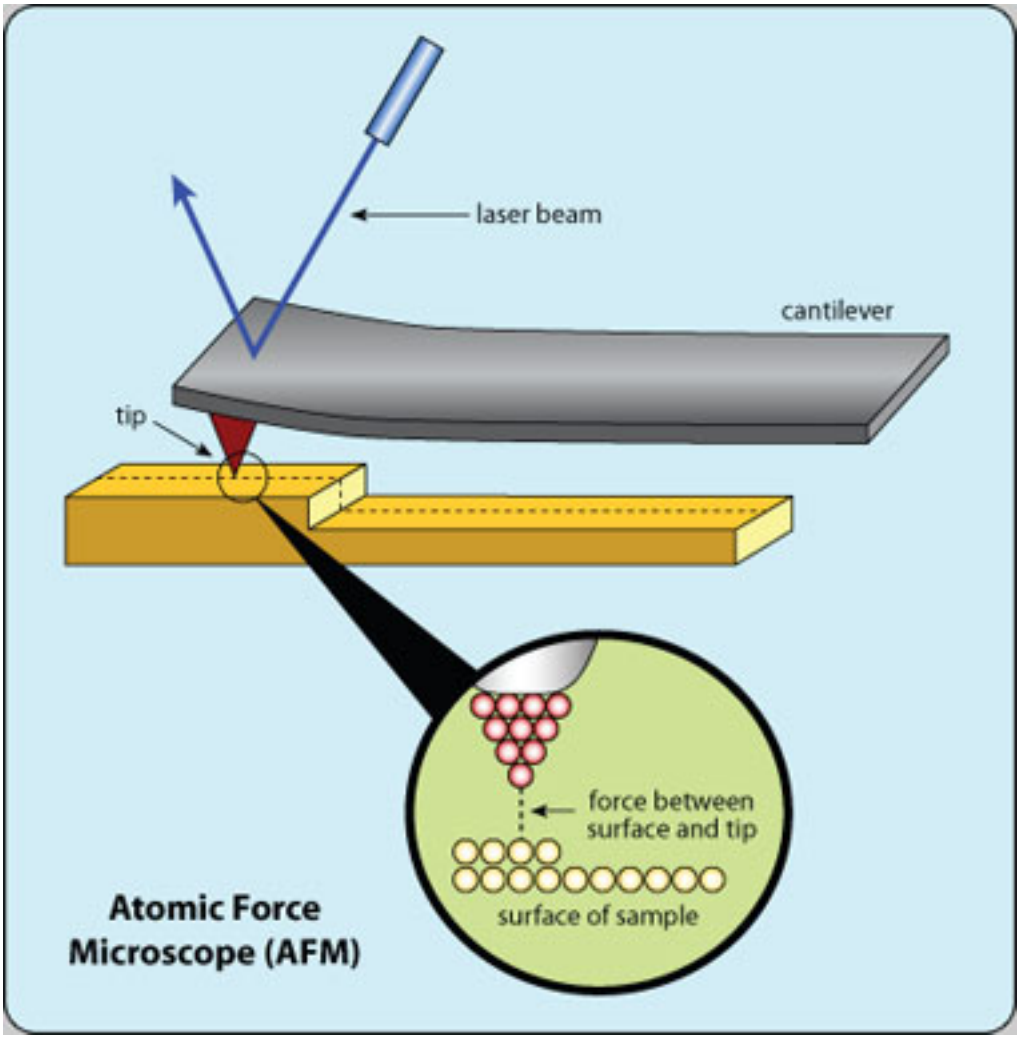
Atomic Force Microscope

Like the scanning tunneling microscope (STM), the atomic force microscope (AFM) uses a probe to scan back and forth over the surface of a sample. But instead of using an electrical signal, the AFM relies on forces between the atoms in the tip and in the sample.



The probe of the AFM is a flexible cantilever—think of a diminutive diving board—with a tip attached to its underside. As the tip scans the sample, the force between them is monitored. To keep the force constant, the cantilever is moved up and down. A detection device, usually a reflected laser beam, measures the vertical movement of the cantilever, which corresponds to the hills and valleys of the sample's surface. A computer translates this vertical movement into an image.

In addition to gathering information about the topography of a sample, the AFM can measure the friction between the tip and the sample, and it can also measure the elasticity, or softness, of a sample.

IBM in xenon atoms: *This striking image taken by Ming Lee Tang at Stanford University shows a very thin crystalline film composed of stacked "terraces" (a 45-nanometer-thick layer of an organic semiconducting compound, a fluorenethiophene-oligomer).*

The AFM can operate in a multitude of different modes. For instance, the tip can be in constant contact with the sample, it can be slightly above the sample, or it can be in "tapping" mode, intermittently tapping gently on the sample. This latter approach works well with soft samples that might be harmed if the tip stayed in contact.

While the STM is generally used with samples that conduct electricity, the AFM can be used with almost any type of material, including biological samples. It's been used to image DNA, individual proteins, and even living cells.

The AFM was developed in 1985 by Gerd Binnig, IBM scientist Christoph Gerber, and Stanford University professor Calvin Quate.