Atomic Force Microscope Encyclopedia Article

Atomic Force Microscope

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Atomic Force Microscope

In recent years, tremendous advances have been made in the field of microscopy. The electron microscope, once considered state-of-the-art, has been made obsolete by the field ion microscope and the powerful scanning tunneling microscope (STM). In 1985 a new member was added to this list: the atomic force microscope (AFM). Invented by Gerd Binnig (co-inventor of the STM), Christoph Gerber in Zurich, Switzerland, and Calvin Quate (1923-) in California, the AFM represents the technological pinnacle of microscopy.

The AFM uses a tiny needle made of diamond, tungsten, or silicon, much like those used in the STM. While the STM relies upon a subject's ability to conduct electricity through its needle, the AFM scans its subjects by actually lightly touching them with the needle. Like that of a phonograph record, the AFM's needle reads the bumps on the subject's surface, rising as it hits the peaks and dipping as it traces the valleys. Of course, the topography read by the AFM varies by only a few molecules up or down, so a very sensitive device must be used to detect the needle's rising and falling. In the original model, Binnig and Gerber used an STM to sense these movements. Other AFM's use a fine-tuned laser.

The AFM has already been used to study the supermicroscopic structures of living cells, objects that could not be viewed with the STM. American physicist Paul Hansma (1946-) and his colleagues at the University of California, Santa Barbara, are quickly becoming experts in AFM research. In 1989, this team succeeded in observing the blood-clotting process within blood cells. Hansma's team presented their findings in a thirty-three-minute movie, assembled from AFM pictures taken every ten seconds.

Other scientists are utilizing the AFM's ability to remove samples of cells without harming the cell structure. By adding a bit more force to the scanning needle the AFM can scrape cells, making it the world's most delicate dissecting tool. Scientists hope to apply this method to the study of living cells, particularly floppy protein cells, whose fragility makes them nearly impossible to view without distortion.