Molecular Imaging of Cells Likely with New Take on Atomic Force Microscopy

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A seminal early event in the history of nanotechnology was the development of the atomic force microscope (AFM), which used a nanoscale cantilever to image solid materials at the atomic level.

The insights gained from AFM studies provided a dramatic increase in our understanding of materials at the nanoscale, and while atomic force microscopy has been used in biomedical research, its applicability in biomedical research has been limited by the fact that AFM does not work well in water.

Now, a team of investigators at Oak Ridge National Laboratory, led by Sergei Kalinin, Ph.D., have developed what it calls piezoresponse force microscopy, or PFM. This new approach to molecular-scale imaging relies on the piezoelectric phenomenon that translates electrical energy into mechanical movement in certain types of materials. Quartz crystals, as well as many biological polymers, such as enzymes and DNA, have the ability to generate piezoelectric responses. The researchers report their work in the journal *Physical Review Letters*.

The new technique uses an AFM microscope modified so that its gold-coated nanoscale cantilever tip is suspended in water just above the surface of a piezoelectric material, such as a quartz crystal. Applying an electric current to the piezoelectric material causes it to move, a event registered by the AFM tip. Using this approach, the researchers achieved an imaging resolution of 3 nanometers. They note that the inherent piezoresponsive nature many biological materials exhibit should allow future imaging of biological structures and their movements under physiological conditions.

This work is detailed in a paper titled, “High resolution electromechanical imaging of ferroelectric materials in a liquid environment by piezoresponse force microscopy.” An abstract of this paper is available through PubMed.

Source: National Cancer Institute