

Electromechanical Imaging of Butterfly Wings and Other Biological Tissue

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Applying state-of-the-art technology to a seldom-exploited electromechanical property in biomolecules, Sergei Kalinin and Brian Rodriguez of Oak Ridge National Laboratory and Alexei Gruverman of North Carolina State University have demonstrated a nanometer-scale version of Galvani's experiment, in which 18th-century Italian physician Luigi Galvani caused a frog's muscle to contract when he touched it with an electrically charged metal scalpel.

The new, 21st-century demonstration promises to yield a host of previously unknown information in a variety of biological structures including cartilage, teeth, and even butterfly wings.

Employing a technique named Piezoresponse Force Microscopy (PFM), Kalinin and colleagues sent an electrical voltage through a tiny, nanometer-sized tip to induce mechanical motion along various points in a biological sample, such as a single fibril of the protein collagen. The electromechanical response at various points of the sample enabled the researchers to build up images of the collagen fibrils, with details less than 10 nanometers in size. This resolution surpasses the level of detail that can be gleaned on those biostructures by ordinary scanning-probe and electron microscopes. The PFM technique exploits the well-known but infrequently used fact that many biomolecules, especially those that are made of groups of proteins, are piezoelectric, or undergo mechanical deformations in the presence of an external electric field.

The researchers have used the PFM technique to produce images of

cartilage as well as enamel and dentin (found inside teeth). Besides providing images of biostructures on a nanometer scale, the new technique yields information about the electromechanical properties and molecular orientation of biological tissue. In recent work, the researchers even found unexpected piezoelectric properties in butterfly wings which enabled them to yield molecular-level images of wing structures.

This and other questions will be addressed on Monday, October 31, 2005, from 1-2 PM, at a press luncheon for the 52nd AVS International Symposium & Exhibition in Boston. (Speaker: Sergei Kalinin, Oak Ridge National Laboratory)

The luncheon will take place in the Exhibitor Workshop area of Exhibit Hall D of the Hynes Convention Center (900 Boylston Street). The entire symposium takes place between October 30-November 4, 2005. The meeting will feature over 1300 papers and posters, with at least 3,000 expected attendees.

Source: American Institute of Physics

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