Ultrasonic-Based Mode-Synthesizing Atomic Force Microscopy

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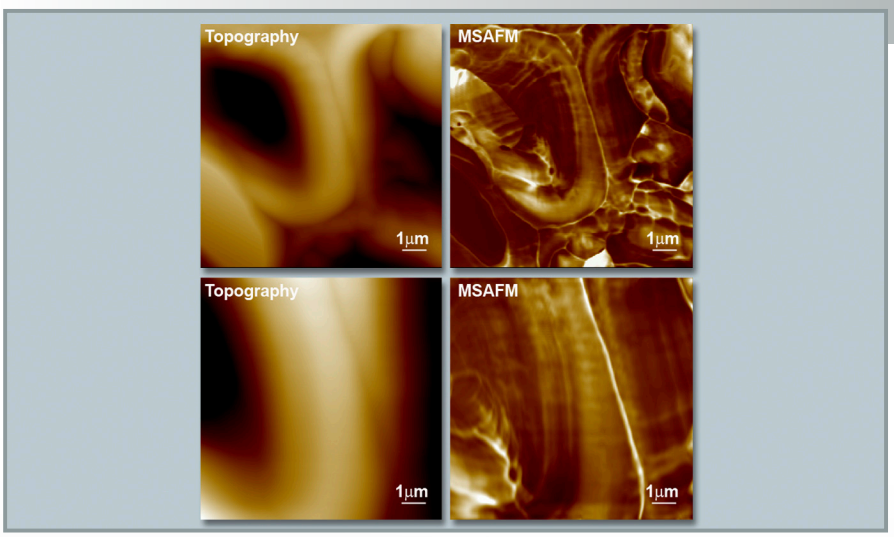

Technology Summary

In a single run and without damaging the sample, ORNL's mode-synthesizing atomic force microscopy (MSAFM), along with mode-synthesizing sensing, acquires a variety of information and allows for new sensing modalities. ORNL's invention uses nonlinear nanomechanical interactions at ultrasonic frequencies to noninvasively and nondestructively detect multiple surface and subsurface properties of materials at the nanoscale.

A microscope capable of nondestructively characterizing nanoscale features, or inhomogeneities, at high resolution is critical to understanding biological processes that lead to cell signaling, protein folding, and gene expression. Using MSAFM, nanoscale properties such as porosity, granularity, elasticity, density, and morphology can all be acquired simultaneously.

A major innovation in bioscience research, MSAFM is equally important for solid-state devices. The characterization of nanoscale subsurface features poses a challenge for the microelectronics industry, and the ability to access and detail buried nanostructures holds great promise in applications such as detecting dopants and defects in silicon chips.

Advantages

- Only ultrasonic-based atomic force microscopy in the industry
- Sufficiently flexible for compatibility with spectroscopic approaches such as Raman spectroscopy
- Easily adaptable to scanning near-field ultrasonic holography, ultrasonic force microscopy, and functional infrared emission spectral microscopy for detecting both surface and subsurface properties of nanoscale materials

Potential Applications

- Study plant cells or other organic systems with a variety of interrelated chemical, morphological, and mechanical properties
- Study biological processes such as cell signaling, protein folding, and gene expression
- Detect the vibrations and natural resonance frequencies of such multicomponent processes
- Characterize solid-state devices whose functional units are usually protected from interactions with the environment

Patent

Ali Passian, Thomas G. Thundat, and Laurene Tetard, *Mode-Synthesizing Atomic Force Microscopy and Mode-Synthesizing Sensing,* U.S. Patent Application 12/726,083, filed March 17, 2010.

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