TECHNOLOGY

Heterodyne Ambient Condition Kelvin Probe Force Microscopy (HAC-KPFM)

OVERVIEW

Background:
Kelvin probe force microscopy (KPFM) adapts an atomic force microscope to measure electric potential on surfaces at nanometer length scales. The original amplitude-modulation Kelvin probe force microscopy (AM-KPFM) method has been used to study numerous phenomena; such as pn junctions, Langmuir films, and crystal orientation of metals. However, in AM-KPFM, the voltage contrast is typically only a qualitative representation of the surface potential due to the averaging effect of the cantilever. The development of Frequency-Modulation (FM) KPFM improved spatial resolution and repeatability and has been used to quantitatively compare nanoscale potential with macroscopic work functions on both semiconductors and graphene. However, in FM-KPFM, the potential and topographic feedback loops are both detected near the first cantilever resonance, which restricts the possible detection bandwidth and, in turn, limits scan speeds.

Innovation:
Researchers at the University of Maryland have developed and implemented a Heterodyne Ambient Condition Kelvin Probe Force Microscopy technique. This technique enables enhanced sensitivity based on amplification of the voltage signal through the cantilever resonance. Heterodyne KPFM improves upon the time resolution of FM-KPFM. Rates of several frames per minute were achieved, resulting in scans being completed in a number of seconds. Also, its speed is not limited by AC coupling or bandwidth overlap, and so with appropriate cantilevers it will operate even faster. The spatial resolution of this technique also supersedes the resolution achievable by AM-KPFM.

APPLICATIONS

Nanoscale potential dynamics investigation
Quality Control

ADVANTAGES

Fast Scanning
High spatial resolution
Operation in air
No additional hardware needed

CONTACT INFO

UM Ventures
0134 Lee Building
7809 Regents Drive
College Park, MD 20742
Email: umdtechtransfer@umd.edu
Phone: (301) 405-3947 | Fax: (301) 314-9502

Additional Information

INSTITUTION

University of Maryland, College Park

PATENT STATUS

Pending

EXTERNAL RESOURCES

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