Band Excitation Method Applicable to Scanning Probe Microscopy

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Technology Summary

Using adaptive band excitation, ORNL researchers invented new scanning probe microscopy (SPM) techniques that offer improved data acquisition, processing, and control. These techniques enable researchers to carry out functional imaging and manipulation down to the nanometer and atomic scale.

The invention can be applied to all force-based scanning probe microscopy techniques, including intermittent contact atomic force microscopy, noncontact atomic force microscopy, atomic force acoustic microscopy, and piezoresponse force microscopy. It is relevant to all SPM manufacturers and can yield data about a sample's electrical, magnetic, and mechanical energy conversion properties at the nanoscale. The invention can also be applied to micro-electromechanical devices and other force-based sensors.

The invention uses a band excitation signal with a predefined amplitude and phase spectrum in a predefined frequency band. A probe is excited, and data are obtained by measuring the probe response in a second frequency band. The approach permits researchers to note tip-surface interactions and energy dissipation mechanisms in exceptional detail.

Advantages

- Maximizes information about tip-surface interactions
- Obtains independent amplitude, resonant frequency, and Q-factor parameters
- Provides characterization of the complete behavior of a system
- Works with a membrane-based sensor, a resonant detection chemical sensor, or a resonant detection biological sensor
- Can be adapted to work with a frictional force or an atomic force microscope

Potential Applications

- SPM equipment manufacturers
- Cantilever based sensor platform and micro-electromechanical systems
- Other SPM techniques, such as intermittent contact atomic force microscopy, non-contact atomic force microscopy, atomic force acoustic microscopy, and piezoresponse force microscopy

Patent

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