Physical Technique | Technology Offer

New Measurement Modes for AFM based on Force Modulated Microscopy to obtain Tribological and Elastic Surface Properties

Field of application

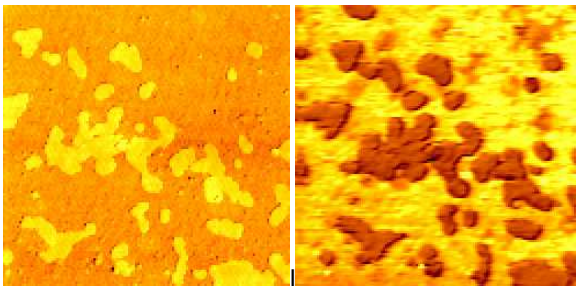
Atomic force microscopy (AFM) is used to study sample surface properties with high lateral resolution. The basic application is to measure the sample surface topography, but the ability of spatially resolved acquisition of mechanical surface properties is an advantage of this method. In this context applications for measurements of friction and stiffness of the tip-sample contact are of great interest. Our new measurement mode is able to improve studies of friction and elasticity of sample surfaces by using a new kind of force modulated microscopy.

Drawback of current technologies

To measure tribological and elastic surface properties by AFM there are quite different modes used. For investigation of friction between AFM tip and sample surface commonly the cantilever torsion is analyzed as an answer of a lateral movement of the surface relative to the tip. A drawback of the widely used lateral force microscopy is the influence of surface topography on the torsion signal. Alternative dynamic methods require an additional equipment effort and have disadvantages at calibration. The most common methods for studying elastic surface properties are normal indentation techniques, such as the force modulated microscopy (FMM). These techniques are limited to comparatively soft samples and high values of cantilever force constant and normal forces. Moreover at FMM friction induced artifacts can be observed. It is the aim of our new technology to overcome those drawbacks.

Secure your innovation advantage

At the Universität Karlsruhe (Germany) a new measurement mode for AFM was developed as well as the corresponding mathematical analysis method to allow local measurements of elastic and tribological (friction) properties. We offer interested companies the opportunity to acquire a license for this innovative technology.



2 µm x 2 µm area of a silicon substrate with islands of pyrolytic carbon. Left image: topography; right: friction contrast observed by our new oscillating friction mode.

Innovation

We developed a new measurement mode for AFM to study local elastic and tribological sample surface properties. The technique allows the evaluation of lateral forces with a normal modulation technique by using the normal force signal. Based on the widely used force modulated microscopy the application to current microscopes is easy and requires no additional hardware. Our new analysis provides on the one hand a dynamic technique for measurement of friction forces, with its increased sensitivity and reduced influence of surface topography compared with lateral force microscopy. On the other hand it is also possible to evaluate the lateral contact stiffness of the tip-sample contact depending on measurement parameters and analysis. In contrast to standard FMM this technique allows to use cantilevers with a bending force constant which is low as compared to the stiffness of the tip-sample contact. In this way soft contact cantilevers and lower normal forces are applicable. Also the contact stiffness of harder samples is accessible.

Your advantages at a glance:

- Dynamic friction measurement with reduced surface influence and high sensitivity using a lock in technique
- Elasticity measurement with lower normal forces and soft contact cantilevers, applicable also to hard samples
- Easy calibration due to normal force detection
- No additional hardware: easy application to current systems

Patent situation

European and US patent applications were filed.
WO 2006/097800 A2 (EP 1877753 A0), US 11/883,900

Technology transfer

The Technologie-Lizenz-Büro GmbH (Germany) on behalf of the Universität Karlsruhe offers interested companies the opportunity to acquire an appropriate license for this innovative technology. Furthermore, the research group offers cooperation for further joint development.

For further information on *„buckling FMM“*, please contact Michael Ott at ott@tlb.de

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