NANONIS APPLICATION NOTE

CONTROLLING QPlus SMALL AMPLITUDES WITH NANONIS SETUP

A growing number of users are opting for a modified setup of their STM combining a standard instrument with a QPlus Sensor to do non-contact AFM. QPlus sensors can be easily integrated with the existing STM head since they are based on oscillations of quartz tuning forks. The detection of such oscillations is done electrically and no additional laser system is required. When combined with low temperature this technique leads to a large spectrum of applications.

We operated our Omicron LT-STM/QPlus microscope with a Nanonis controller together with the digitally integrated oscillator controller OC4. The Nanonis adaptation kit (AK-OM4) is pin-compatible with the original Omicron cables and allows direct connection between microscope and Nanonis controller. The AK-OM4 provides optimized, low-noise power supplies for the both Omicron preamplifiers, the tunneling current and QPlus preamplifiers. We performed non-contact AFM measurements achieving atomic resolution on KBr(100) at low temperature (see Fig. 1). The tip height was controlled by keeping constant the frequency shift of the QPlus resonator. The signal is directly proportional to the gradient of the interaction force between the tip and sample. The QPlus is a very stiff sensor, thus scans at small oscillation amplitudes favor measurements of short range interaction forces. The PI parameters for amplitude and phase of the PLL can be automatically set using the perfectPLL™ module (see Fig. 2).

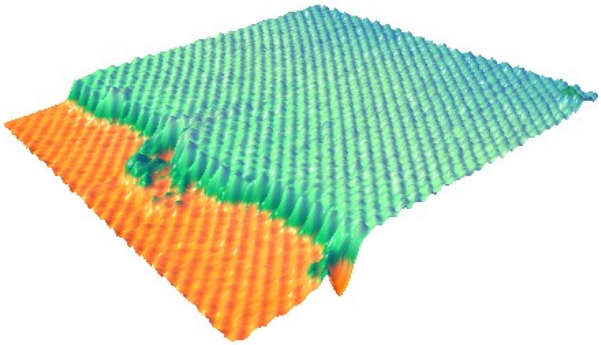

Fig. 1. Atomic resolution on KBr(100) using a QPlus sensor and the Nanonis controller. Measurements done at 77K with a peak-to-peak amplitude around 800 pm and z-controller setpoint Δf= - 6.8 Hz in attractive regime. The quality factor of the QPlus sensor was about 8000 at a resonance frequency f_0=25.298 kHz.

This kind of measurements encourages the investigation of heterogeneous surfaces like organic molecules on insulating samples which are often too unstable or too mobile for being imaged at room temperature.

Reference:
http://nanolino.unibas.ch/

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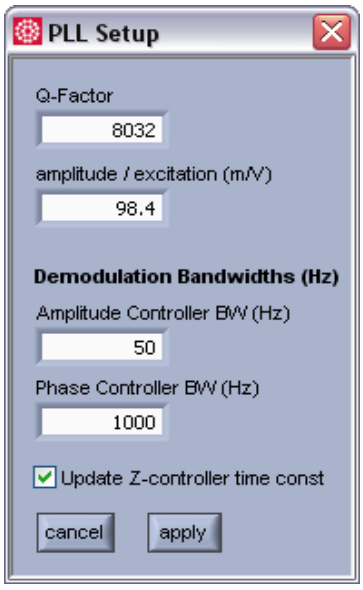

Fig. 2. PerfectPLL™ software module with two demodulation bandwidths. The amplitude should be demodulated slowly preventing disturbances of such small signals, while the phase is detected at higher frequencies for fast scanning.

Nanonis Modules in Use:

- Base Package
- Nanonis HV-Amplifiers HVA4
- Oscillation Controller OC4
- Omicron Adaptation Kit AK-OM4
- perfectPLL™

System:

- Omicron LT-STM with QPlus

NANONIS
The SPM Application Experts

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