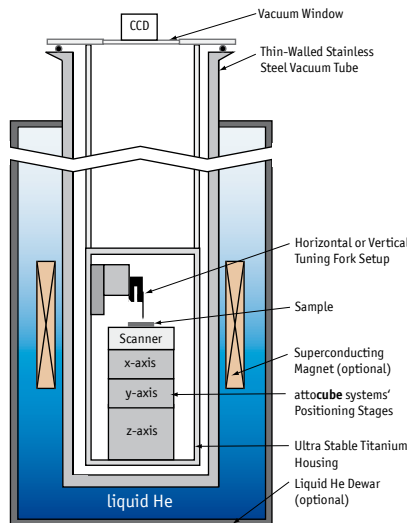


# Tuning Fork based AFM Measurements of uncapped, stacked InAs Quantum Dots in a GaAs matrix.

The attoAFM III is a tuning fork based setup for highly precise low temperature measurements. The non-optical design facilitates e.g. measurements on light-sensitive samples using conductive STM-type tips.

The distance feedback is done by detecting the tuning fork vibration using a Phase-Locked Loop (PLL) together with a feedback loop. The PLL tracks the resonance of the tuning fork, whereas the feedback loop keeps the z-distance in such way that the frequency shift (vs. the free oscillation) remains at a certain level. Deriving from the measurements which are presented in this application note, the z-noise (RMS) of such measurements is typically as low as 30pm.

The sample under investigation features stacked, uncapped InAs quantum dots in a GaAs matrix. As can be seen from the topography image (Figure 1a), the dots are about 300 nm x 100 nm in size while having a height of about 4 nm (the scan size is ~2 x 2 μm<sup>2</sup>). Especially in the error image (Figure 1b), one can see atomic steps in the surrounding InAs.



Schematic drawing of the attoAFM III

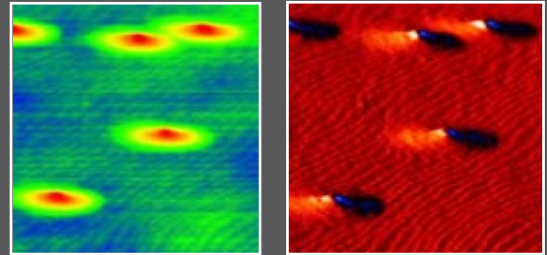


Fig. 1: Tuning fork AFM measurements of uncapped, stacked InAs Quantum Dots in GaAs at ambient conditions (attocube application labs, 2008).



Fig. 2: Detailed topographic image when performing a scan of 0.5 x 0.5 μm<sup>2</sup> (attocube application labs, 2008).

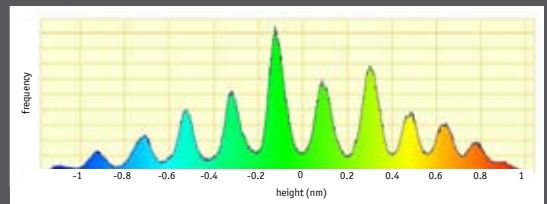


Fig. 3: AFM height distribution data extracted from Figure 2 yielding the atomic step height (attocube application labs, 2008).

On another spot of the sample, this has been investigated in more detail (Figure 2). Clearly spaced steps are visible in this graph. The height distribution is presented in Figure 3, showing atomic steps with a spacing of ~2.04 +/- 0.02 Angstrom. This corresponds to the atomic lattice constant of InAs of ~2.15 Angstrom. The small difference is most certainly due to the scanner calibration.

As mentioned above the roughness analysis yields an RMS roughness value of ~30 pm in this measurement, showing the excellent stability and low-noise of the attoAFM III instrument.

## RELATED PRODUCTS

attoAFM III	low temperature atomic force microscope, tuning fork based sensor
ANPxyz101/LT	high precision, piezo electric, inertial positioner
ANSxyz100sr/LT	xyz-scanner with high resolution z-range
ASC500	SPM controller
ANC250	scan voltage amplifier