

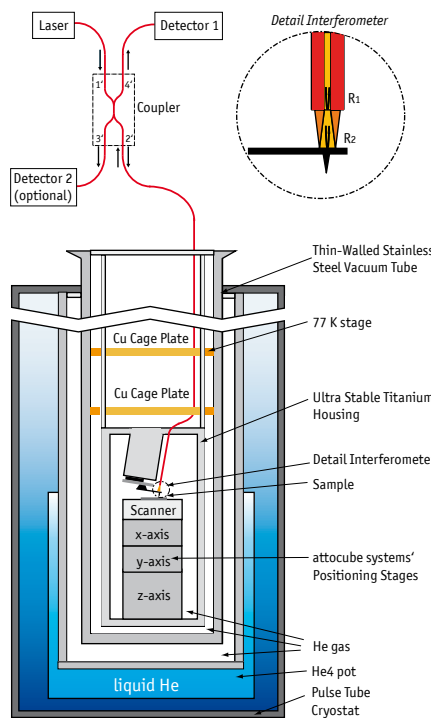
Atomic Force Microscopy in combination with a Pulse Tube Cooler

As liquid Helium is nowadays not always available or even not desired the use of cryogen-free cryostats is becoming increasingly important for many applications. In a previous collaboration with VeriCold Technologies attocube systems has developed a high-resolution low temperature confocal microscope combined with a low vibration pulse tube cooler.

A new and one of the most recent developments of attocube systems is the combination of the ultra stable attoAFM I with a cryogen free pulse tube cooler. The outstanding stability of the AFM module in combination with the pulse tube cooler which has been optimized for low vibrations allows for ultra high resolution imaging of nm-features over a wide temperature range (4 K ... 300 K) without the need for liquid Helium.

Figure 1 (a) shows the cross-section of the pulse tube cooler. All moving parts in the cold head are eliminated to achieve very low vibrations. In Figure 1 (b) the applied AFM module is presented. It enables AFM measurements in contact mode with the cooler on as shown in Figure 2 and Figure 3. The investigated sample was a Si/SiO₂-substrate with a height difference of 20 nm +/- 2 nm.

In conclusion it can be stated that the low vibrations of the cryostat and the highly stable AFM module enable highly resolved AFM measurements. The cryogen-free handling allows for plug-and-play operation and adds to the simplicity of this complete low temperature atomic force microscopy system.



Schematic drawing of the attoAFM I inside a pulse tube cooler.

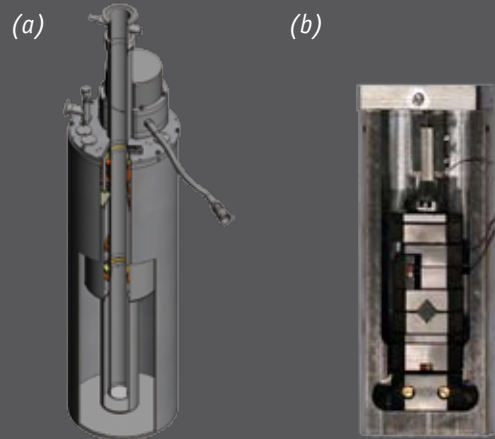


Fig 1: (a) Cross-section of closed-cycle cooler, (b) AFM module.

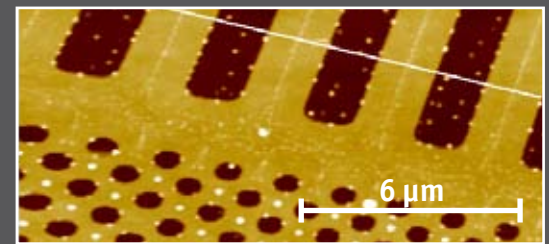


Fig 2: AFM contact mode image of a Si-substrate/SiO₂-layer; height: 20 nm +/- 2 nm recorded at 10 K using a closed cycle pulse tube cooler. The images were recorded with the cooler on! (attocube application labs, 2007).

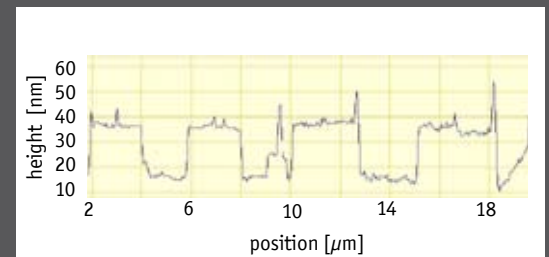


Fig. 3: AFM height profile data of the Si/SiO₂ sample with a grating height of 20 nm recorded at 10 K (attocube application labs, 2007).

RELATED PRODUCTS

attoAFM I	low temperature atomic force microscope, interferometric sensor
ANPxyz101/LT	high precision, piezo electric, inertial positioner for big loads
ANSxyz100sr/LT	xyz-scanner with high resolution z-range
ASC500	SPM controller
LTSYS-Cc	cryogen-free low temperature physics measurement system