# Atomic Force Microscopy (AFM)

AFM enables 3D imaging of surfaces on micro- to nano-scales and complements other imaging techniques such as CLSM, SEM and OM.

## AFM Bruker Dimension Icon ScanAsyst

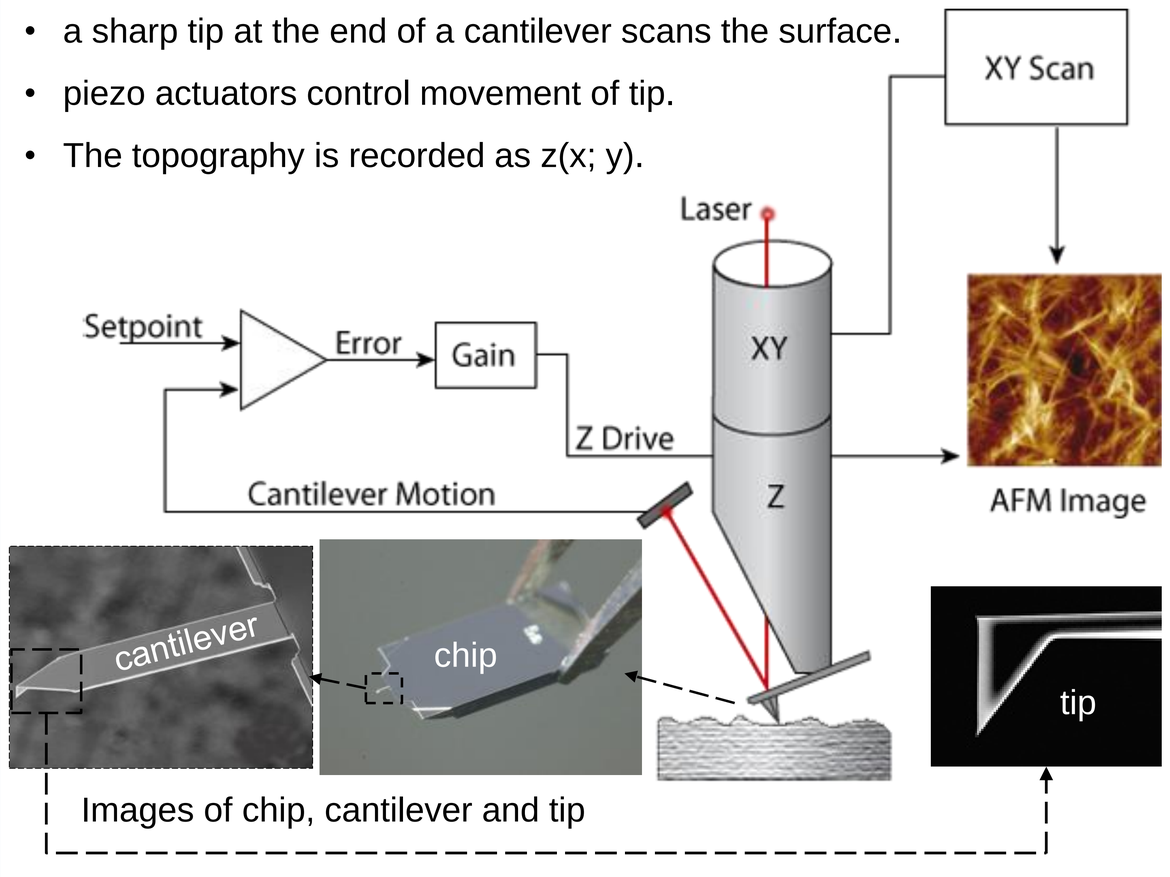
- Z range = 14 µm
- Lateral range = 80 × 80 µm
- Modes:
  - Contact
  - Tapping
  - ScanAsyst
  - Contact resonance
  - MFM
- Motorized sample stage
- Motorized Z stage


Table: comparison of different imaging techniques

| Imaging technique | Resolution XY | Resolution Z | Acquisition time | 3D imaging |
|---|---|---|---|---|
| **Optical microcopy** | ~200 nm | - | Fast | No |
| **SEM** | ~2 nm | - | Medium | No |
| **CLSM** | ~125 nm | ~10 nm | Medium | Yes |
| **AFM** | **~1 nm** | **~0.1 nm** | **Slow** | **Yes** |

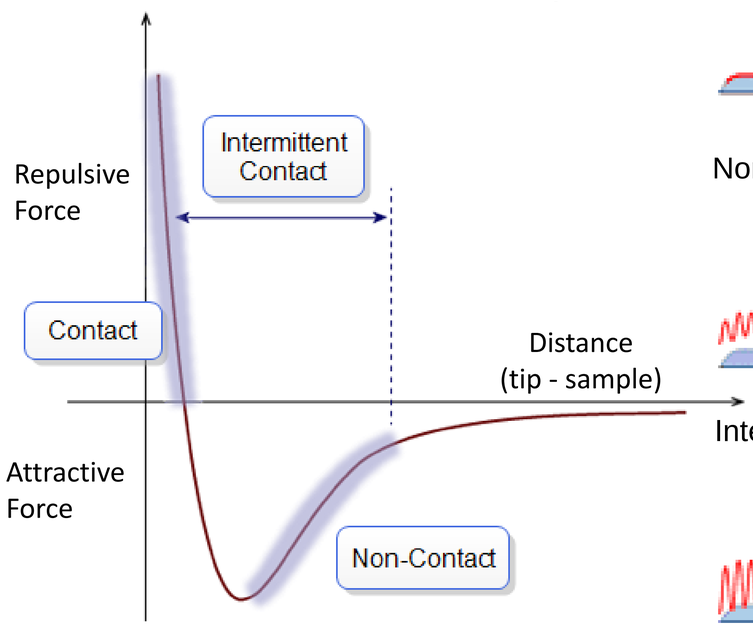
## AFM Principle

- a split photodiode detects the laser beam reflected by cantilever.
- a sharp tip at the end of a cantilever scans the surface.
- piezo actuators control movement of tip.
- The topography is recorded as z(x; y).

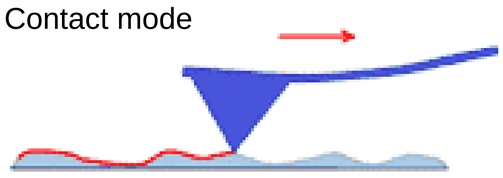



## AFM modes: tip – surface interactions

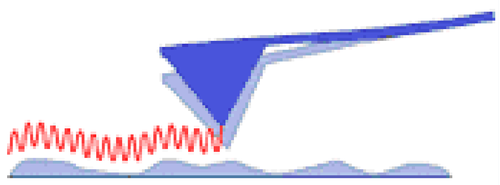
- 3 principle AFM modes act as foundation for other AFM techniques.



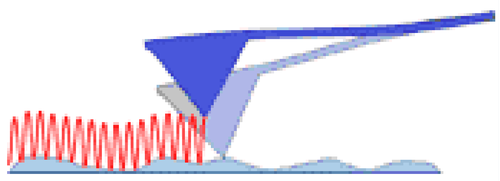

Contact mode



Non-contact mode

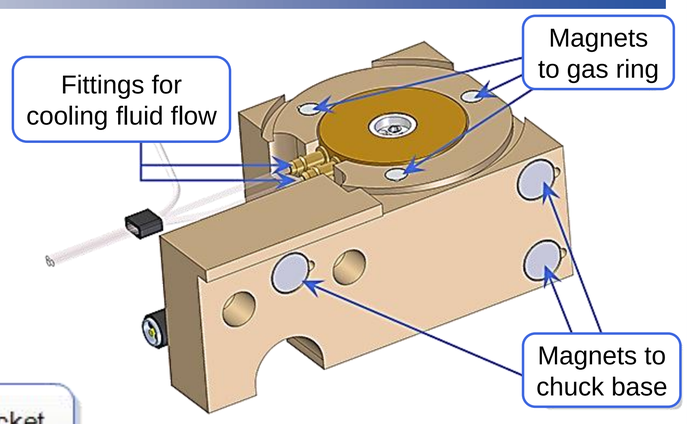


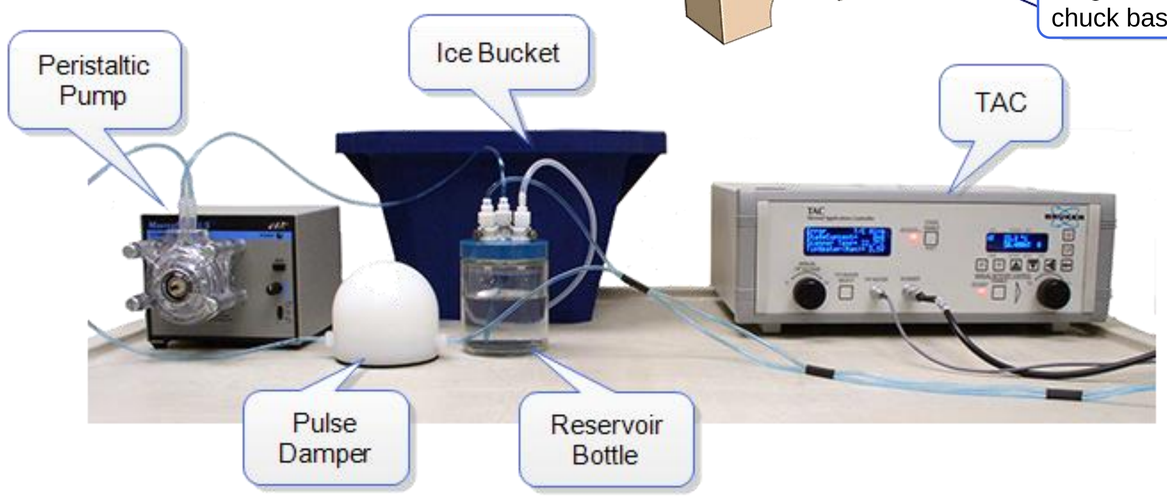
Intermittent contact mode



## Thermal Applications Controller: heater/cooler

- AFM at temperature range of -35 to 250°C possible.
- A manifold enables flooding with gas to prevent condensation and oxidation.




Note: Many images on this poster taken from the Bruker Dimension Icon User Guide

**Examples:** thickness measurement on gold film - different surfaces - buckling on MoO/Al/MoO multilayers