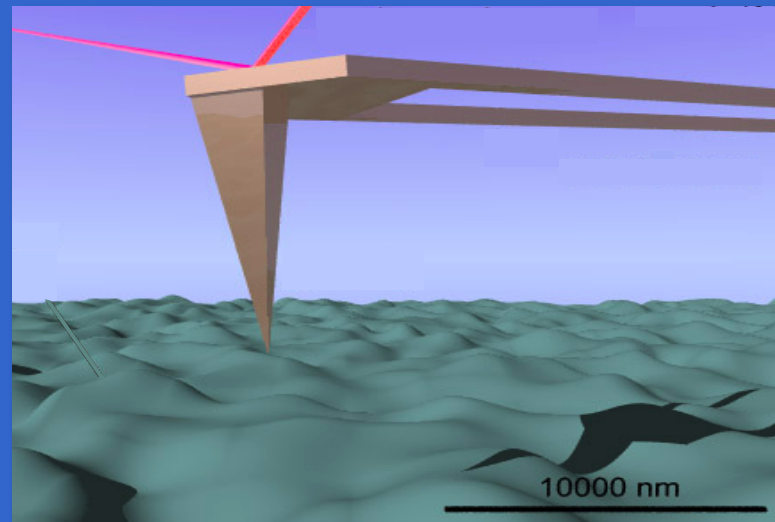
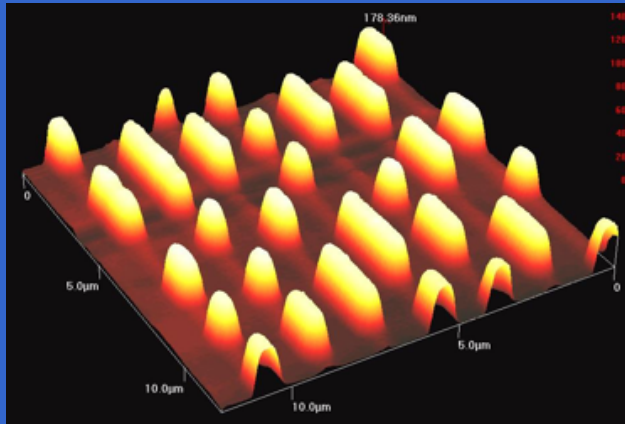


*Get to the
point!*

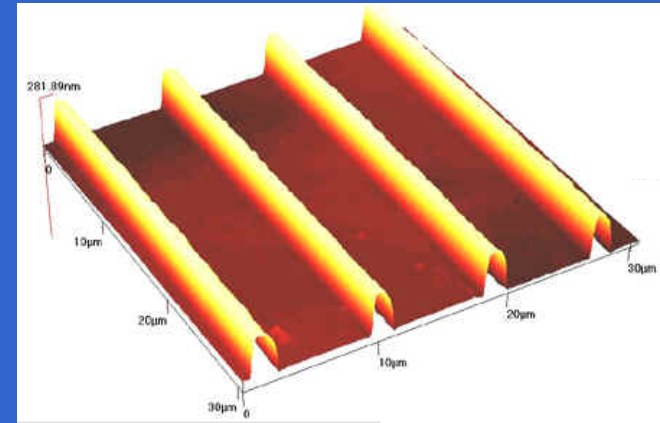


AFM - atomic force microscopy

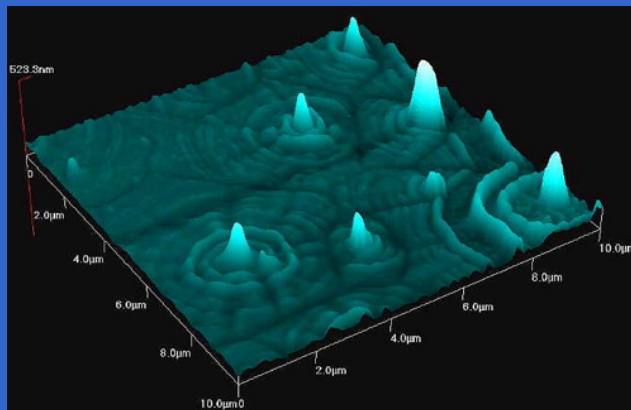
A 'new' view of structure (1986)



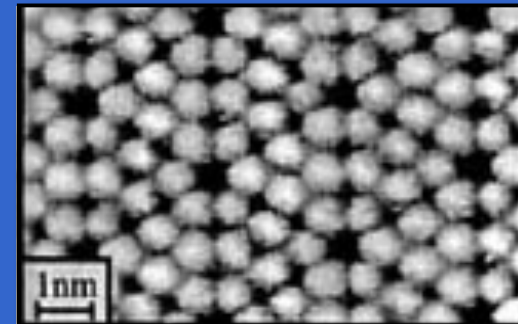
CD stamper



AlGaN/GaN quantum well waveguide



polymer growth



surface atoms on Si single crystal

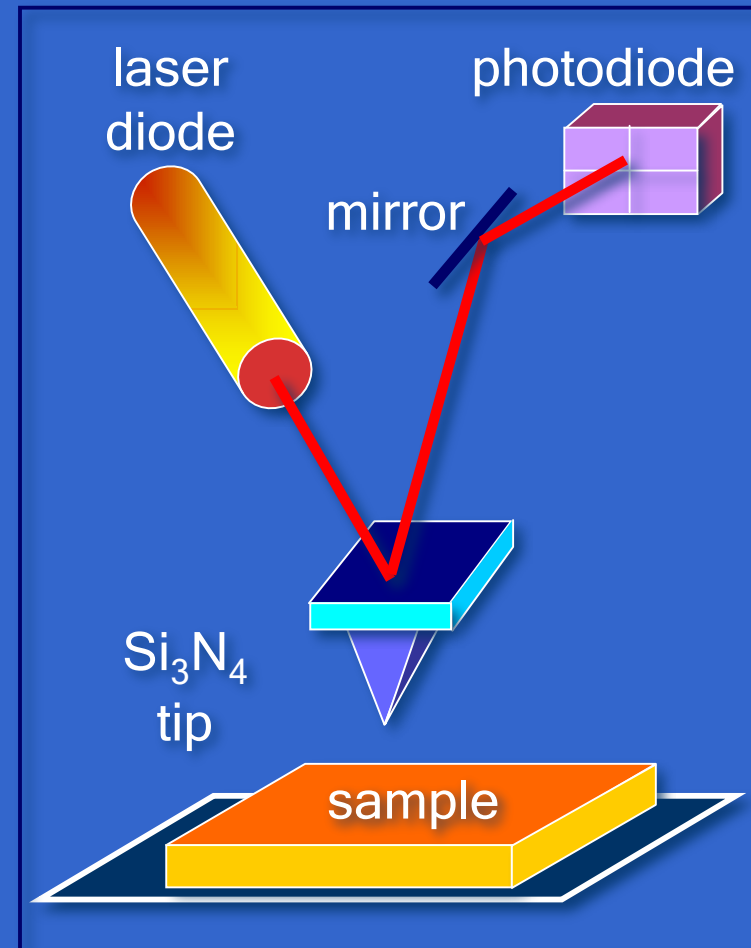
See *Vocabulary of Surface Crystallography*,
Journal of Applied Physics 35, 1306 (1964),
by Elizabeth A. Wood

AFM - atomic force microscopy

How does the microscope work?

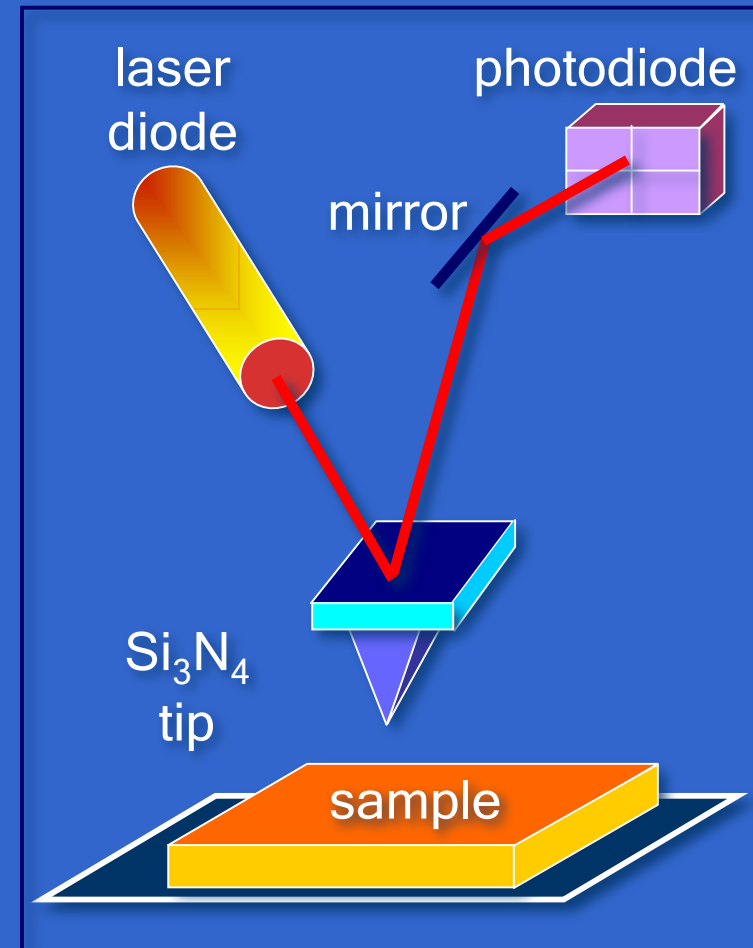
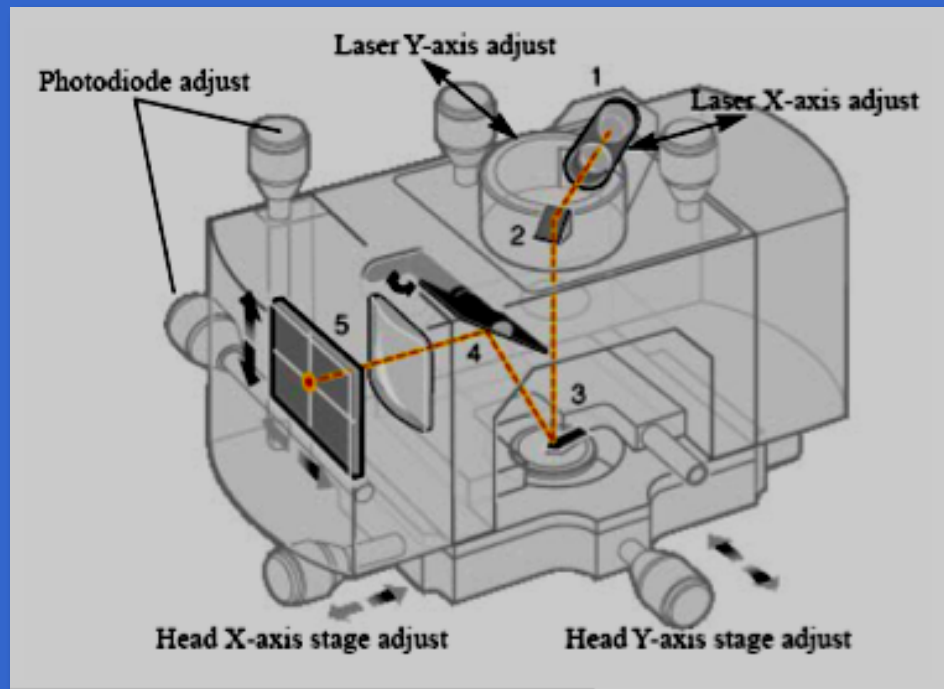
Tip scans sample

Up and down movement of tip
recorded by position sensing
photodiode



AFM - atomic force microscopy

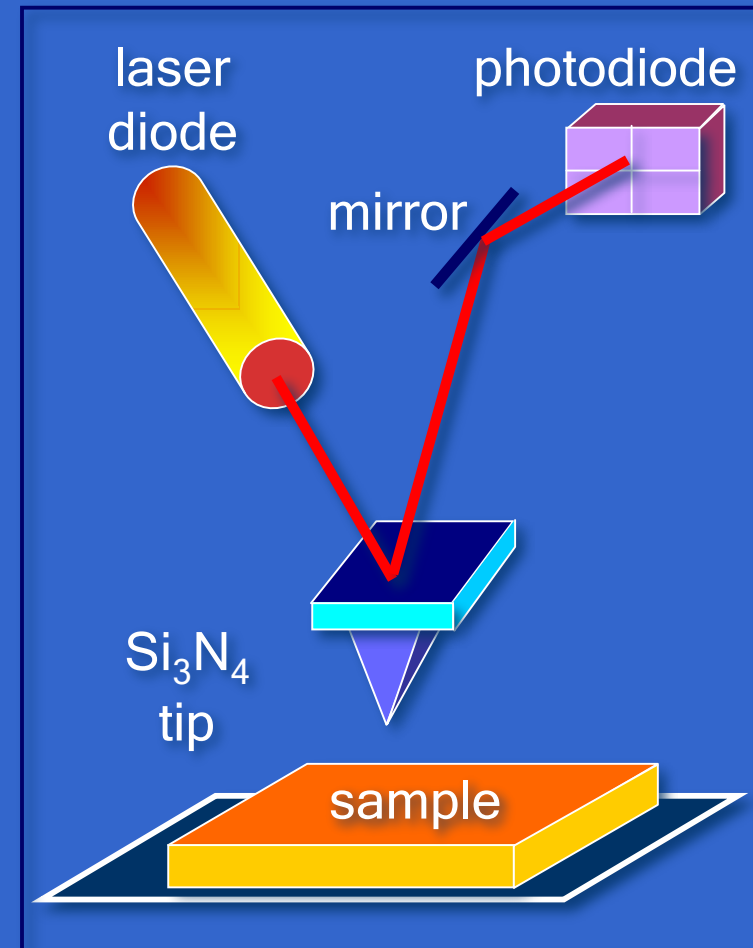
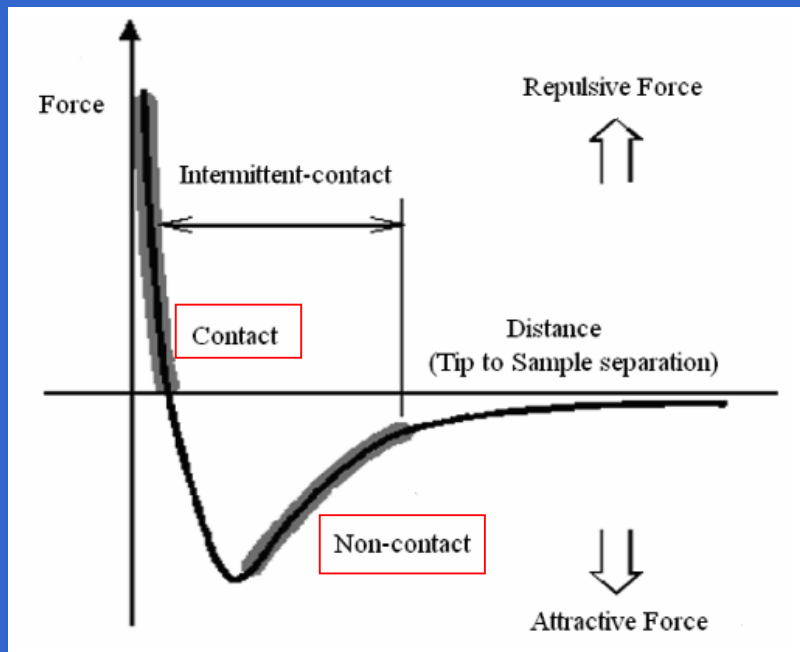
How does the microscope work?



AFM - atomic force microscopy

How does the microscope work?

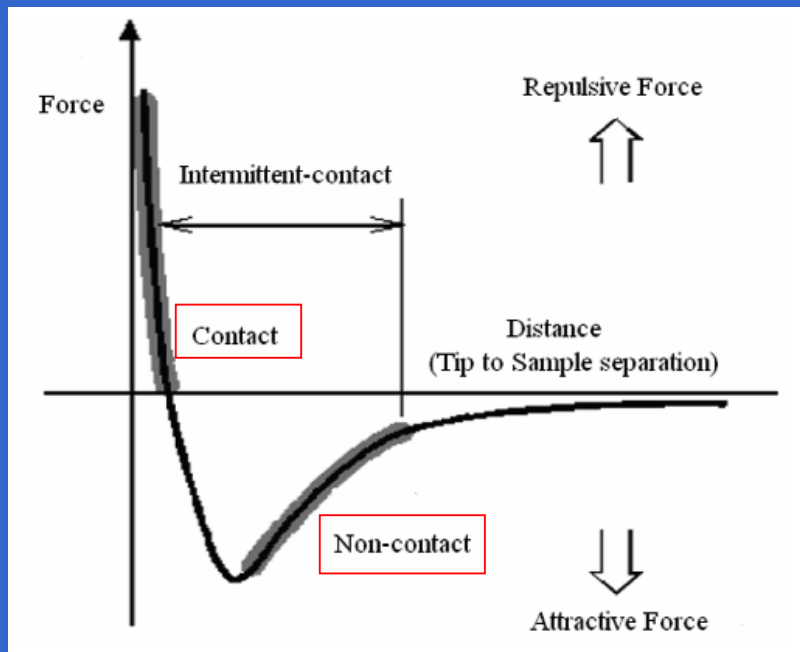
Two modes of operation



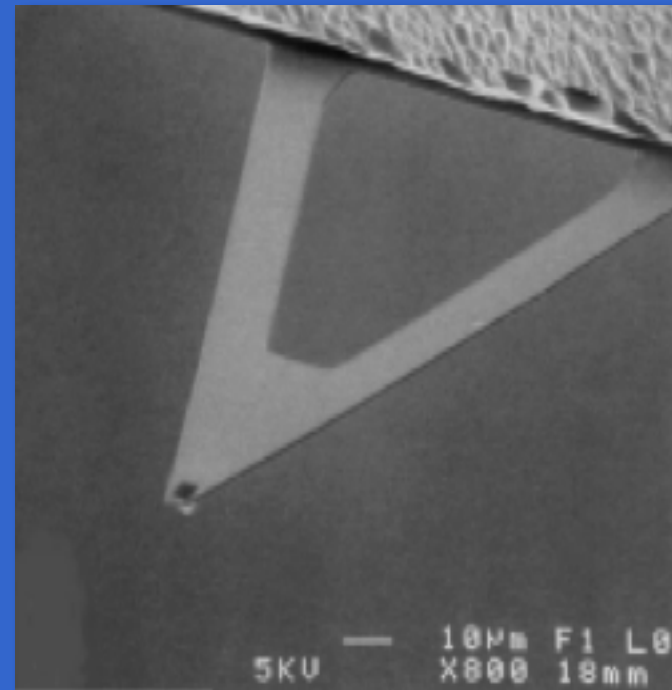
AFM - atomic force microscopy

How does the microscope work?

Contact mode - short-range interactions (\AA) - interatomic forces



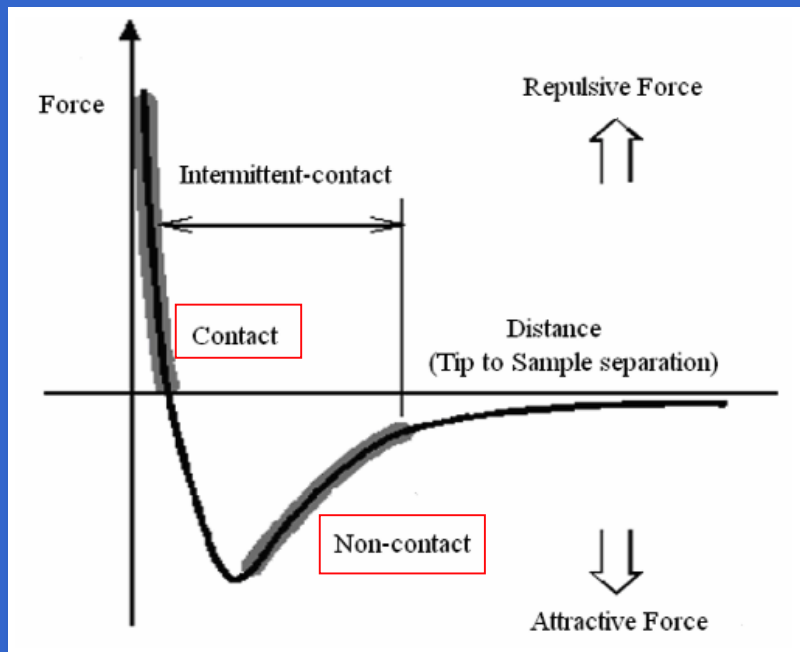
Tip: 5-20 nm radius, 10-25 μm high, on 50-400 μm cantilever beam



AFM - atomic force microscopy

How does the microscope work?

Contact mode - short-range interactions (\AA) - interatomic forces



Detector system can measure deflections in nm range

Tip: 5-20 nm radius, 10-25 μm high, on 50-400 μm cantilever beam

Cantilever: low stiffness - can't deform surface

Tip contacts surface

Tip scans surface: either tip or specimen moved by piezoelectric positioning system over x and y

AFM - atomic force microscopy

How does the microscope work?

Contact mode - short-range interactions (\AA) - interatomic forces

Two ways - 'constant force' feedback system
moves tip in z direction to keep force
constant

'constant height' no feedback system -
usually used when surface roughness small
higher scan speeds possible

AFM - atomic force microscopy

How does the microscope work?

Tapping mode - long-range forces - van der Waals, electrostatic, magnetic

Tip vibrates (10^5 Hz) close to specimen surface (50-150 Å) with amplitude 10-100 nm

May at times lightly contact surface

Suitable for soft materials



AFM - atomic force microscopy

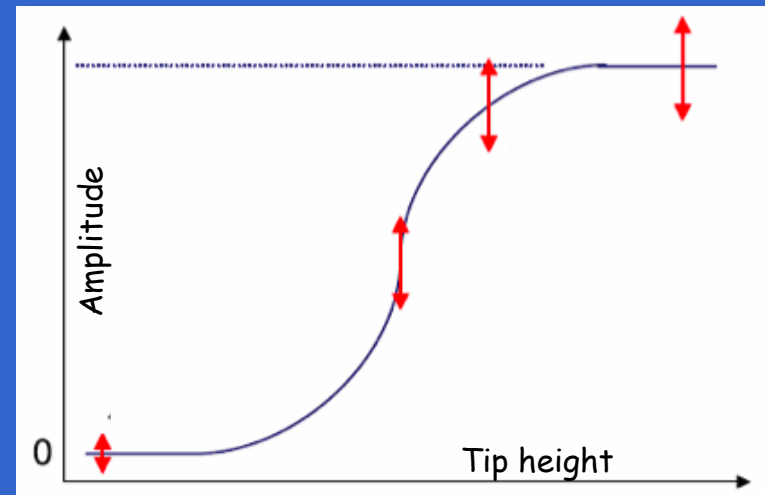
How does the microscope work?

Tapping mode

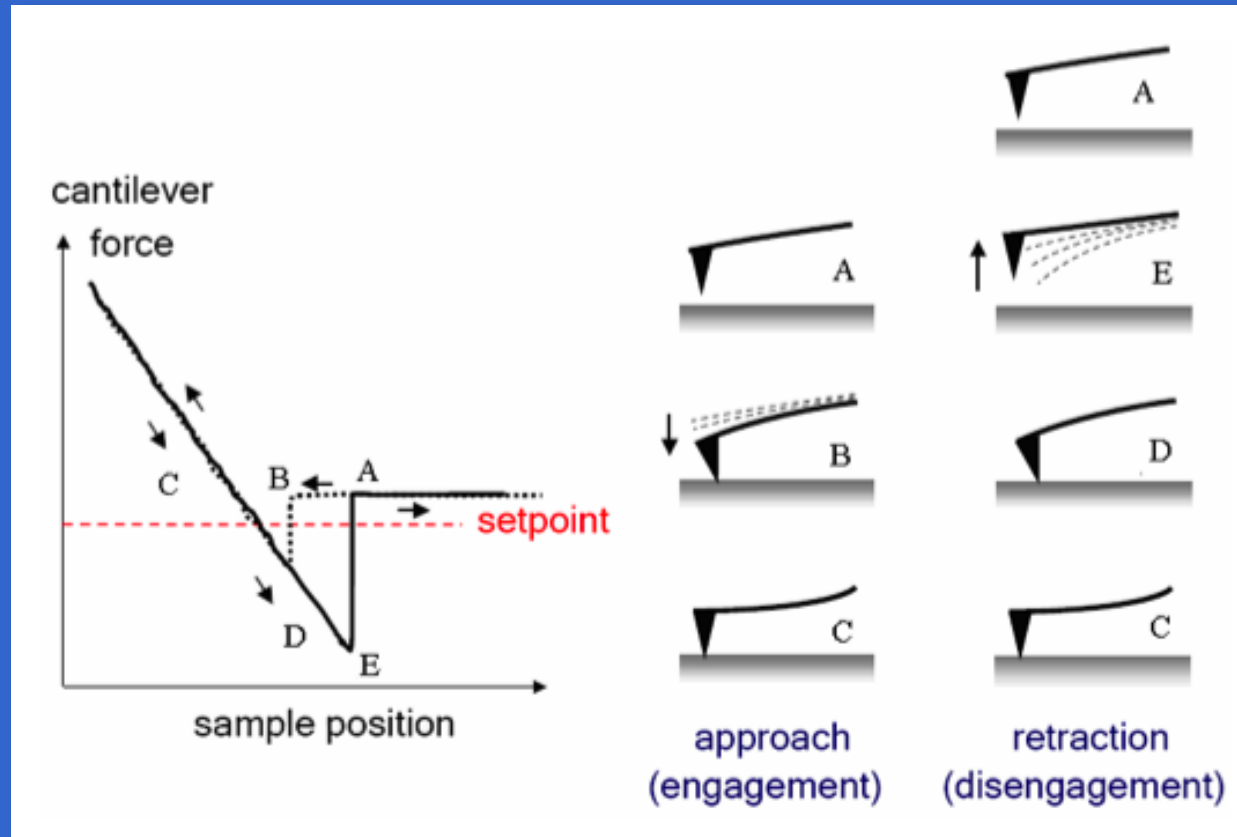
Tip vibrates (10^5 Hz) close to specimen surface (50-150 Å) with amplitude 10-100 nm

May at times lightly contact surface

When near or on surface, oscillation is damped - tip z position corrected so that vibration amplitude stays constant



AFM - atomic force microscopy



From force-distance plot, can get:
range & magnitude of attractive & repulsive forces
elastic modulus & adhesion energy