Afm prelab

1. How does atomic force microscopy differ from other forms of microscopy (e.g. SEM or optical)? What are advantages? Disadvantages? An AFM makes a map of a samples topography using force measurements. This is done with a cantilever and a spring. The deflection distance of the cantilever allows one to map a surface. It can be used on non-conductive surfaces unlike STMs and is usable in any conditions (ambient, vacuum, etc). Optical and electron microscopes can get great magnification but can’t measure vertical dimension of the sample, the height of particles or depths of holes/pits. One can get magnifications of up to 1,000,000x.
2. What is a piezoelectric transducer? Where are they used in our AFM, and why are they used? Piezoelectric materials flex when voltages are applied. They are used to adjust the height/positions of the tip.
3. Draw, and briefly explain the different features of the typical force distance curve for a material. Be sure to note the attractive and repulsive regions, why these different regions exist and which AFM modes operate in which regions. / it starts repulsive brief attractive then goes to 0. In repulse regime there is contact mode (vibrating mode) in attractive regime there is non-contact mode.
4. Explain how an AFM takes a scan of a sample. How does the AFM produce a 3D image? You should explain the laser and detector, cantilever, tip, feedback loop, and z piezo. Also explain the differences between non-vibrating (constant force, and constant height) mode and vibrating mode. Identify which modes you will use in this lab and when you will use them. // an afm measures the force felt from the surface atoms and maps the surface. The laser shines light off the cantilever tip and the detector measures changes wiht respect to the set point. This tells the system to adjust the z-piezo through a feedback loop. This adjustment in the z-piezo gives a measurement of the system’s height which is then processed by computer with known parameters. In this lab we will use primarily vibrating mode. Idk when non-vibrating mode?
5. Explain what the important parameters do in the Scan Setup, Topo Scan, and System tab (frequency select, manual z motor control, automated tip approach, range check, scan lines, scan size, rotation, Z feedback, display, HV Z gain, XY parameters, tip approach parameters, calibration) ???
6. Give examples of two scenarios where you are likely to break a tip. BE VERY CAREFUL. ???

Notes from shitty eric’s video

Non-vibrating and vibrating modes

Z-piezo

Afm maps the topography of a sample

Non-vibrating is first mode- operates in replsive region of force distance cuve

Constant force and constant height

Constant force uses feedback loop

Cantilever deflected by some distance D

It works be monitoring position of laser in detector, changes in position are measured by reflection off tip

F=-kd

Target value for deflection is called setpoint, try to keep laser posiition at constant position

Uses feedback loop

Scan approaches a surface feature cantilever deflects because of increased atomic force, causing laser position to change

System responds thru feedback loop by adjusting z-piezo (applying a voltage)

Monitoring how z-piezo changes gives a topographical map of the surface

Vibrating mode -constantly feedback loop to adjust z-piezo. Drive cantilever at resonant frequency with some input signal, the detector should see a sine wave. The tip and sample interaction causes a damping of the output signal to the detector.

afM data

First scan- 0 degrees like 4:56 pm on 4/19

Second scan 90 degrees rot at 5:17 on 4/19

Second day 4/20

Doing silicon wafer chip

First noise floor experiment-closed box,

Third day

Did cd, dvd, microprocessor , hopg, graphene, and graphite

Fourth day

Started with glue,

Fifth day

Silicon wafer, took ten scans for force distance

Switch to spring constant

The resonsnat frequency is 169.45 MHz