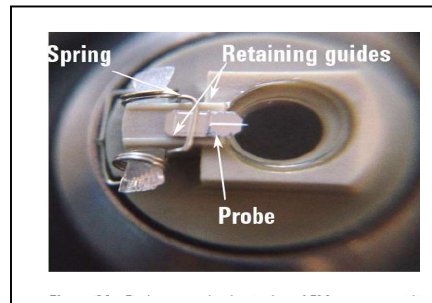


## Atomic Force Microscopy

### Agilent 5420 Procedures

**Warning:** This instrument may only be operated by those who have been trained by AAF staff and have read and signed the AAF laboratory policies.

- I) Reference Agilent 5420 User Guide Manual
- II) Open Pico View 1.12.4 software
- III) Mount Tip/Cantilever Chip
  - a) CONTACT TIP
    - i) Mode (pull-down window) click Contact Mode
    - ii) In Laser Alignment Win see Deflection, Friction, dashed yellow line, and open red circle
    - iii) Remove Scanning head from instrument bracket. First slide out CCD, Unplug Red and Blue plugs. Next open bracket and extract scanner head assembly.
    - iv) Place Scanner on holder
    - v) Remove tip if there and place in appropriate box
    - vi) Mount Tip (lift spring and slide chip holding tip in position) Please pick contact tip



- vii) Replace scanning head on 5420
  - b) Align Contact Tip
    - i) Use polished Si as sample
    - ii) Turn on Camera light
    - iii) In Controls drop down menu click Camera View. If camera “view” not seen, Click Camera ICON (top right). In Camera setting window, first click no camera and then USB Video Device. Cantilever should be seen in camera now. (focus on cantilever)

- iv) Plug in Blue Cable
- v) Turn on Laser
- vi) Adjust Laser position to end of cantilever (nice reflected laser spot on screen)
- vii) Slide in CCD detector in position (take notice of position)
- viii) Align CCD so that Deflection is (-1.2V) and Friction is 0.0V
- ix) Place sample in position.

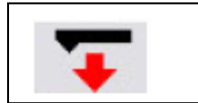
#### IV) Engage tip and sample

- a) Lower scanner so that tip is ~2mm above sample
- b) Focus on sample and cantilever (what is focus rotation adjustment? 90deg???)



Figure 62 Adjusting the video system focal plane

- c) “Slowly” lower tip to the point where cantilever sample focus difference is 45deg.
- d) Lower jack stand to remove 5420
- e) Plug in red cable
- f) Set point (servo window) 0.2V
- g) Scan and Motor Window - Motor drop box select stop at 0.0V – speed 4um/sec reset position to zero.
- h) Click-on Approach ICON



- i) See Approach in Progress
- j) Deflection will stop at (0.2V) when tip engaged.

#### V) Set Parameters to Get Best Image

- a) Start I Gain 5% and P Gain 90%
- b) Scan drop-down menu (In Scan and Motor Window) size 1um, speed 11n/sec points 512

- c) Start scan up or scan down
- d) Check Trace/Retrace output (do they overlap and have no noise?)
- e) If they do not overlap, slowly increase set-point until they do.
- f) Slowly increase I Gain % until lines get noisy and then drop number down ...

**VI) Scan Sample Image**

- a) Set image size, speed, points/line and angle desired.
- b) Complete 1 scan and stop.
- c) In Realtime images window, Save Now AS DESKTOP/DATA/...
- d) Click Withdrawal Tip ICON
- e) Tip up 1-2 cm

**VII) Align AC or Non-Contact TIP**

- a) Mount a NC H (high frequency) or L (low frequency) Cantilever/Tip
- b) Align Laser at the end of Tip (Laser ON) Blue cable plugged in.
- c) Slide in CCD detector (align Deflection 0.0 and friction 0.0)
- d) All white slides on CCD should be down
- e) Mode drop-down pick ACAFM
- f) AC Mode Tune ICON click (also in Controls Drop-down)
- g) Need to find Resonance of cantilever
- h) In Manual drop-down (upper-right) of AC Tune start 10kHz to 350kHz
- i) Should see resonance of cantilever (NCH~300kHz NCL~100kHz)
- j) Slide red dashed vertical line to resonance
- k) Highest voltage should be ~3V (change by Amplitude Drive % ~1-3)
- l) Set Red dashed line to -0.15 kHz lower than Max. Resonance shifts to lower KHz when the sample is encountered.
- m) Close AC Tune Window

**VIII) Engage Non-Contact Tip (AC Tip)**

- a) In Scan and Motor window – Motor drop-down Stop at 98% and speed 2um/sec
- b) Lower (by hand) tip to about 2mm of sample
- c) Adjust Tip/Sample distance to a 45deg difference in focus.
- d) Plug in Red cable if needed
- e) Click on Engage ICON
- f) See Approach In Progress window
- g) Record Set Point while tip is moving down to engage (this is free vibration amplitude)
- h) When tip engages (98%), record set point.
- i) Set I Gain % to 5 and P Gain % to 90
- j) In Scan And Motor Window, choose Scan pull-down
- k) Size 1um speed 1line/sec and points 512

- l) Click scan up or down
- m) Slowly *Reduce* set point for best image (Trace/Retrace match ??)
- n) Adjust I Gain and P Gain for best image.
- o) Save Good Image
- p) Dis-Engage Tip
- q) Tip up 1-2 cm
- r) Remove Tip/Chip and replace Scanner Head

IX) VIEW IMAGE (ANALYSIS)

- a) Open Pico Image Basic
- b) File - Open - Studiable-
- c) Operators-Surface Extraction (pick image to “study” – Right click to change palette)
- d) Operators – Line Correction (choose line by line or column by column)
- e) Operators – Line Removal , removes bad line(s)
- f) Studies – Parameter Table (gives roughness parameters)
- g) Operators - Profile Extraction See (save) line profiles
- h) Studies – 3D
- i) Reserves with color scale
- j) In “elements to display” ICON – click axes system and xyz graduations.
- k) SAVE IMAGES - Export the Reserve Image

X) Leave 5420 AFM for the Day

- a) Scanner all the way up
- b) Laser and Microscope light OFF
- c) Unplug Red and Blue cables.
- d) Slide CCD detector out and place to side.
- e) Raise Lab Jack to take instrument weight off bungee cords
- f) EXIT PICO VIEW and IMAGE