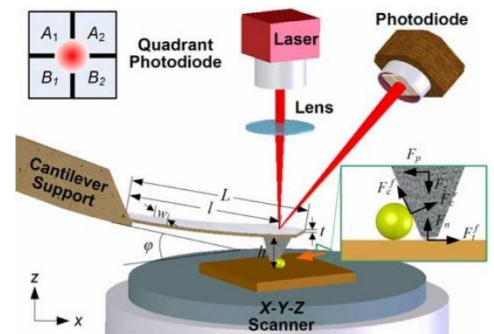


# AFM Workshop's LS-AFM (Life Sciences Atomic Force Microscope)

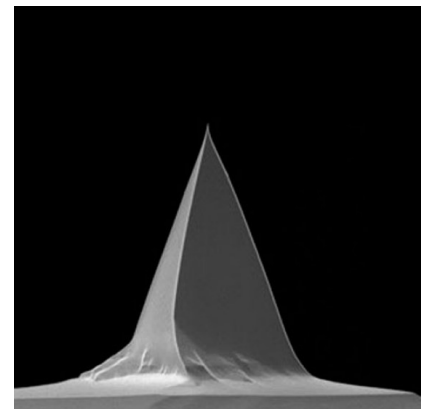
## Introduction

In an AFM (atomic force microscope), a probe is scanned over a surface and the motion of the probe is monitored to create a three-dimensional image of the surface. These unique instruments are capable of measuring high-resolution images in both ambient air and liquids, with surface features of only a few nanometers in size. The three-dimensional motion of the sample (or probe) is generated by piezoelectric ceramics. These sensitive ceramics allow motions as small as a fraction of a nanometer. Typically, the sample (or probe) is moved in a raster pattern as the probe glides across the surface.



A light lever sensor is used for controlling the force of the probe on the surface while the sample is scanned. The light lever reflects a laser beam off the surface of a cantilever into a photo-detector. As the probe interacts with a surface, the cantilever deflects, and this motion is sensed by the photo-detector. With this light lever, forces as small as a pico-newton are possible. With such small forces, very small probes may be used. With micro-machining methods, probes can have diameters of only a few nanometers.

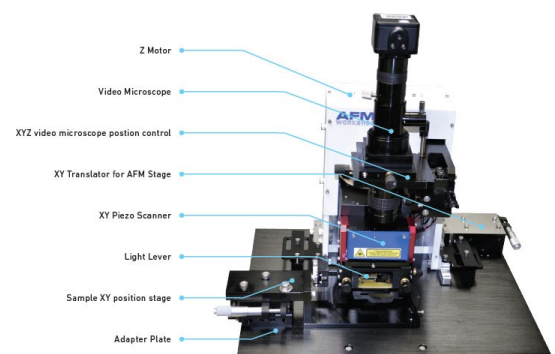
The light lever can be made more sensitive by vibrating the cantilever with a small piezoelectric ceramic and modulating the light. When the vibrating probe interacts with the surface, the amplitude of vibration may be monitored and used to control the probe's force on the surface.



Modern atomic force microscopes include not only a probe and piezoelectric scanner, but additional hardware for bringing the probe rapidly into the proximity of a surface. A video optical microscope is very helpful for operating an AFM. The video microscope helps with aligning the light lever and probe approach, and for finding features for scanning. For an in-depth description of AFM instrumentation, we recommend the book *Atomic Force Microscopy* by Peter Eaton and Paul West. This book provides a complete theoretical, as well as practical explanation for the design and application of AFMs.

## Stage

Samples are held and scanned on the AFM stage. On the upright inside the stage is a linear translator which moves both the light lever force sensor and the piezoelectric scanner in a vertical direction. The stage also includes a base plate fitted with precision XY translators. Optimal images are measured with the AFM stage if it is in a vibration- and acoustic-free environment. If necessary, a vibration and acoustic isolation system should be used. On the back cover of the stage is a modes connector. Signals required for implementing additional modes such as conductive AFM, STM, and EFM are provided.



## Software

The TT-2 AFM includes three separate software modules in the AFM Installation files: AFM Workshop Acquisition Software, Video Microscope Software, and Gwyddion ImageAnalysis Software.

### **Gwyddion Image Analysis Software**

Gwyddion is open-source software and the latest version of this image-analysis software is available on the Internet at: <http://gwyddion.net/>. The functions of the Gwyddion imageanalysis software are:

1. Processes such as leveling, deglitching, and smoothing which alter the images.
2. Display functions which change how the data is viewed, including 2-D, 3-D, light shading, and color mapping.
3. Analysis options that are used for obtaining measurements from images, such as lineprofiling and histogram analysis.

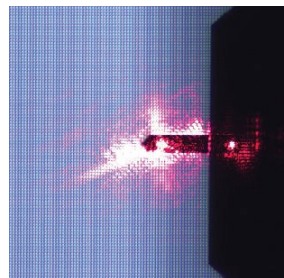
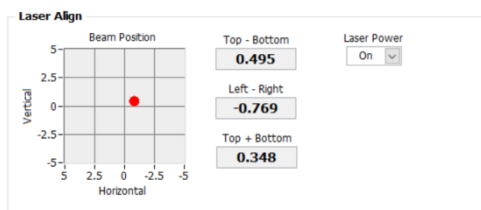
### **AFM-View Software**



Once launched, the AFM-View software has four screens that can be viewed by pressing the tabs at the top right-hand side of the screen. The first tab is for the Pre-Scan window and the second tab is for the Scan window. These two windows are all that are needed for measuring AFM images. The third tab labeled System is used for several other functions, such as measuring the Z noise floor and XYZ scanner calibration. There is a fourth tab that, when activated, permits force-distance curve measurements.

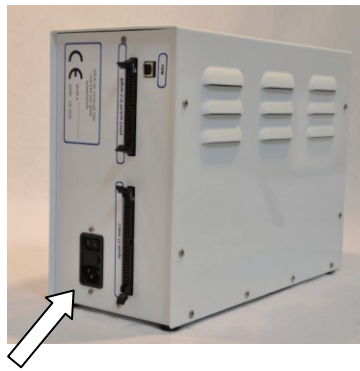
## Working

Before starting the work with the scanner and the software, you need to Laser Align.



See V 1.1 / LS-AFM Users Guide

1. Switch **ON** the EBOX



2. Switch **ON** the PC



3. Enter to the **AFM Control software**



4. Press **Range Check** button (1)

5. Once The **Range Check** Button is Valid, Press **Test Probe Alignment** button (2)

(for non vibrating mode jump to the step 8 )

6. Press **Start Frequency Tune** button and find/fix (move **blue line**) the highest amplitude from the histogram table

7. Change the frequency range to find the pic (move **green** and **red lines**) (3)  
If the blue line is on the top of the pick (on highest rate of amplitude )

8. Press **Start Approaching** button (4)

9. When the **Open Loop** button is on (on feedback ) , use **Jog Up** and **Jog Down** buttons to stabilize the z-drive ( cursor must be in the middle)

10. Go to **Topo Scan** window



11. Chose the picture quality , number of lines and the scanning speed
12. Press **Start Topo-Scan** button.
13. During the scanning, use GPYD controller to get the best quality .
14. When scanning end, saving window will open automatically.  
Change the name (if needed), chose the place (folder) and press **Save**.
15. In **Topo-Scan** window press **Tip Retract** button.
16. When the **Tip is Retracted**, You can go to **Pre-Scan** window, or close the **Software**.
17. **Switch off the E-Box**.
18. **Switch off the light controller**.

For more detailed review, you can see the following links :

[https://www.afmworkshop.com/afm-products/atomic-force-microscopes/lis-afm?srsltid=AfmBOopIxDEN4tWKZoFOhXhNv4cJQHcb1RW5iUxOYJJ3V\\_1pXNzKiok5](https://www.afmworkshop.com/afm-products/atomic-force-microscopes/lis-afm?srsltid=AfmBOopIxDEN4tWKZoFOhXhNv4cJQHcb1RW5iUxOYJJ3V_1pXNzKiok5)

<https://afmhelp.com/docs/manuals/10-1121-16%20LS-AFM%20Manual%20v1.1.pdf>

For Measuring and Understanding Force Distance Curves

<https://www.afmworkshop.com/images/datasheets/Measuring-and-understanding-force-distance-curves-v2.pdf>