

Electrostatic Force Microscopy

(EFM) is a type of dynamic non-contact atomic force Microscopy where the electrostatic force is probed.

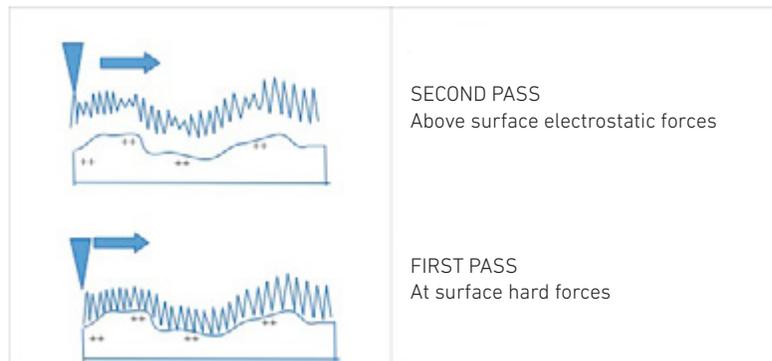
“Dynamic” here means that the cantilever is oscillating and does not make contact with the sample. This force arises due to the attraction or repulsion of separated charges. It is a long-ranged force and can be detected 100 nm from the sample.

The **EFM-2017** module is used for measuring EFM images in the TT-X, NP, LS, and SA-AFM products.

In EFM, a conductive cantilever tip is used on a sample prepared with surface potentials. The tip and sample are separated by a distance z usually by air or vacuum. A bias voltage between tip and sample is applied by an external voltage supply that forms a capacitor, C , between tip and sample. The capacitance of the system depends on the geometry of the tip and sample. The total energy stored in that capacitor is $U = 1/2C\Delta V^2$. The work done by the voltage supply to maintain a constant voltage, ΔV , between the capacitor plates (tip and sample) is $-2C*U$. The z component of the force (the force along the axis connecting the tip and sample) is thus:

$$F_{electrostatic} = \frac{1}{2} \frac{\partial C}{\partial z} \Delta V^2$$

When the tip scans the surface of a sample at close distances (< 5 nm), not only long range electrostatic forces are sensed, but also van der Waals force, atomic interaction forces. In order to reduce topography artifact in the EFM image, a second path of scan at a lifted distance from the surface topography is implemented. The commercial implementation of this method is so-called “Lifting” method.



SPECIFICATIONS

- » Scan Size Scanner Dependent
- » Scan Rate 0.1 -2 Hhz
- » Lift Magnitude* 0 – 10 V
- » Lift Ramp Rate* 19.5 V/Msec
- » Drop Ramp Rate* 19.5 V/Msec
- » Interscan Delay 0 – 10000 msec
- » Field Amplitude 0-100%
- » Bias Voltage 0-10V
- » Vibrating Mode Fr. 20-600 Khz
- » Probe Conductive

*Multiply X Gain in nm/V to convert from volts to nanometers

INCLUDE WITH EFM OPTION:

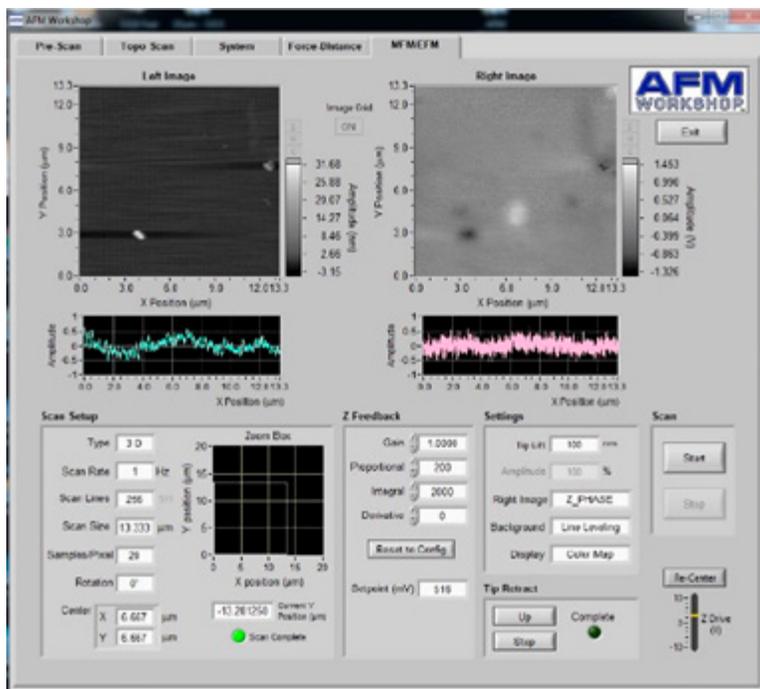
- Conductive Porbes
- Power Supply
- Software
- Sample Holder
- Manual

► Power Supply



A power supply is used to directly supply a biast to the probe or the sample.

► Interface Unit



In the EFM image acquisition tab, the topography image is displayed at the right and the EFM image is displayed at the right.