

AFM Modes Kit Option

Atomic Force Microscopy (AFM) modes enable the measurement of electrical and magnetic sample surface properties and tip-sample interactions. Measurements of surface properties and tip-sample interactions are extremely important for the investigation of, for instance, surface electronic states, corrosion processes, and surface chemistry in general. Properties such as surface charge density, potential, conductivity, and capacitance are some important electrical properties that can be measured using AFM modes. Applications in solar energy, flash memory, and a variety of semi-conductor electronics can directly benefit from such measurements.

Our field measurement technique, the pick-up mode, allows the user to collect both topography and field data in one single pass at a constant distance above the surface throughout the entire image. With this method the tip follows a trajectory over the surface with a form similar to a square wave (see Figure 2). Each period of the waveform corresponds to one pixel, in which two measurements are obtained. When the tip is in contact with the surface the instrument performs the topography measurement: the Z-feedback loop is operating and provides the measurement of the topography. In the second half of the wave period, the Z-feedback loop is momentarily inactive, the tip is elevated to a user-defined distance (pick-up distance) and the field measurement is obtained. The time during which the pickup measurement is performed and the feedback turned off is very short so that the tip does not have time to drift and crash. Because of this, the pickup mode is significantly better than any dual-scan technique.

The AFM modes kit provided by NanoInk includes conductive AFM (C-AFM, for measurement of conductive surfaces), electrostatic force microscopy (EFM), and magnetic force microscopy (MFM). Current measurements are obtained with low-noise electronics located directly under the scanner, just a couple of inches from the tip. The specialized conductive AFM tips are connected to the electronics via a flexible miniaturized coaxial cable to minimize noise.



Figure 1: AFM Modes bottom board attached to the DPN 5000 system scanner.

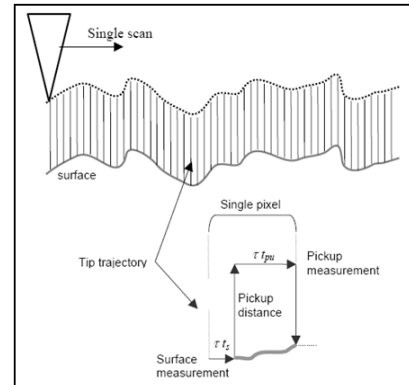
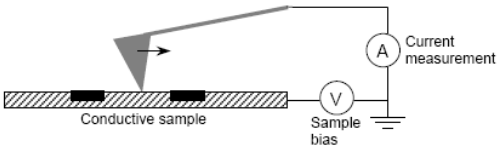
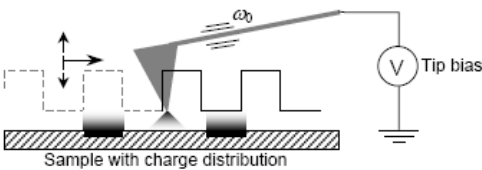
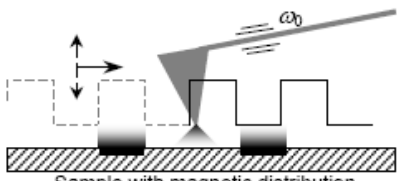


Figure 2: Schematic of Pick-Up Mode.

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(continued)

Field measurements (EFM and MFM) are obtained by monitoring the phase change, which is directly associated to the frequency shift produced by the field gradient (magnetic or electrostatic). Field maps are then acquired while the tip is vibrated at its resonance frequency.

<p>C-AFM</p>  <p>Conductive sample</p> <p>Current measurement</p> <p>Sample bias</p>	<p>Current Gains (noise) for C-AFM: LO 20 $\mu\text{A}/\text{V}$ (450 pA/$\sqrt{\text{Hz}}$), MED 200 nA/V (5 pA/$\sqrt{\text{Hz}}$), HI 2 nA/V (65 fA/$\sqrt{\text{Hz}}$)</p> <p>Max scan rate in Pick-up mode:</p> $v = [2(t_{pu} + t_s)\tau(N_I + 2N_{OS})]^{-1}$ <p>where t_{pu} and t_s are pickup and surface time factors (user defined >0.1), and N_I and N_{OS} are image and over scan pixels, respectively, and $\tau = Q/\pi f$ is the cantilever ringing down time.</p> <p>Sample/tip bias (AUX OUT1-2): $\pm 5\text{V}$</p> <p>Pick-up distance: 0-10 μm</p> <p>I/V Output: $\pm 5\text{V}$</p>
<p>EFM</p>  <p>Sample with charge distribution</p> <p>Tip bias</p>	
<p>MFM</p>  <p>Sample with magnetic distribution</p>	

Item Name: Option, AFM Modes Kit
 Part #: DPN-0310-01
 Compatible with the DPN 5000 System

Learn more about NanoInk products and services at www.nanoink.net. Or call us at 847-679-NANO (6266).