HD-KFM III

Nano-Observer II

www.csinstruments.eu - info@csinstruments.eu

CSI Concept Scientific Instruments

HD-KFM III: Advanced Single-Pass Kelvin Probe Force Microscopy

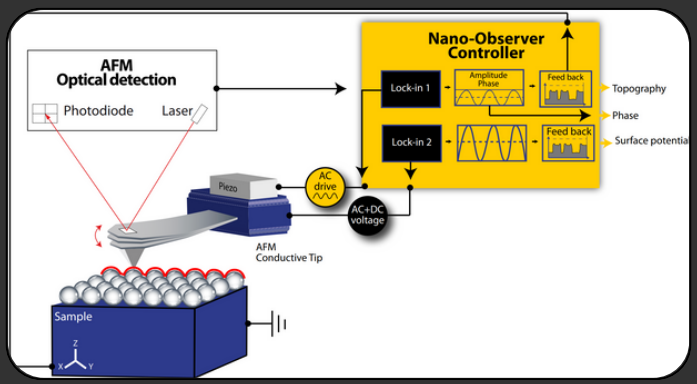
HD-KFM III™ represents the cutting edge of Kelvin Probe Force Microscopy (KPFM) technology. This advanced module for the Nano-Observer II AFM offers unparalleled sensitivity and resolution in single-pass mode, revolutionizing surface potential measurements at the nanoscale. HD-KFM III provides quantitative results of local surface potential distribution and, when calibrated, the work function of samples with exceptional accuracy.

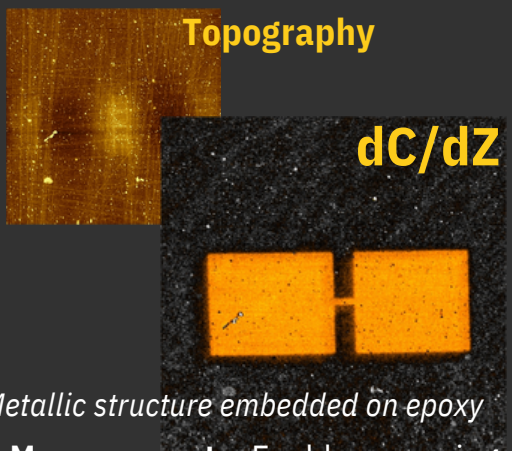
Key Features and Advantages

Single-Pass Technique: HD-KFM III operates in a single-pass mode, eliminating the need for a lift scan. This approach keeps the AFM tip closer to the surface, resulting in improved spatial resolution and sensitivity compared to traditional dual-pass techniques.
Dual-Frequency Excitation: The system utilizes two distinct frequencies - one for topography and another for surface potential measurement. This separation allows for simultaneous, independent acquisition of both topography and electrical data.
Bimodal Operation: HD-KFM III excites the cantilever's second eigenmode for electrical measurements, providing several benefits:
Enhanced Signal Amplification: The VAC bias is fine-tuned to the second eigenmode, amplifying the signal by the Q factor.
Improved Stability: The stiffer effective spring constant of the second eigenmode ensures more stable oscillation during surface scanning.
Smaller VAC Values: Maintains a strong signal-to-noise ratio with reduced applied voltage, minimizing sample perturbation.
High Sensitivity and Resolution: Operating at a typical minimum tip-sample distance of 0.1-0.5 nm, HD-KFM III probes an electrostatic field 100-10,000 times stronger than standard KFM techniques.

HD-KFM Mode Working Principle

In HD-KFM mode, the cantilever vibrates at two different frequencies: the first is used to capture topographical data, while the second is tuned to capture surface potential information. This dual-frequency operation improves signal-to-noise ratios and sensitivity by leveraging the amplified response of the second eigenmode. The setup enables precise, high-resolution mapping of surface electrical properties, such as potential variations, without the need for multiple scan passes.





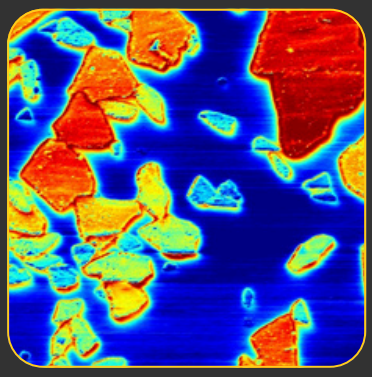
Metallic structure embedded on epoxy

Dc/Dz Measurements: Enables mapping of dielectric constants and investigation of thin film properties at the nanoscale.

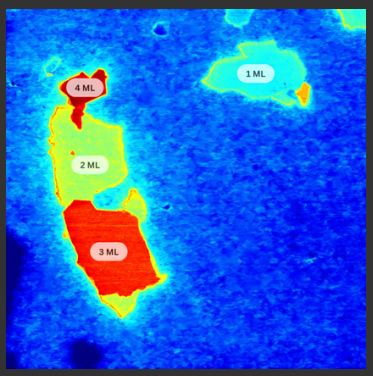
EFC (Electrical Field Compensation for MFM): Allows for pure magnetic measurements without electrostatic interference, crucial for accurate characterization of magnetic nanostructures.

Optional Lift Mode: For samples with large height variations or when separating long-range electrostatic forces from short-range forces is necessary.

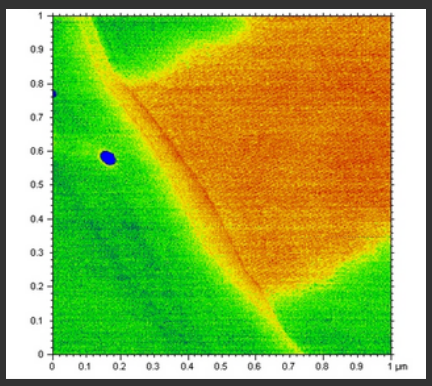
Application fields & Results



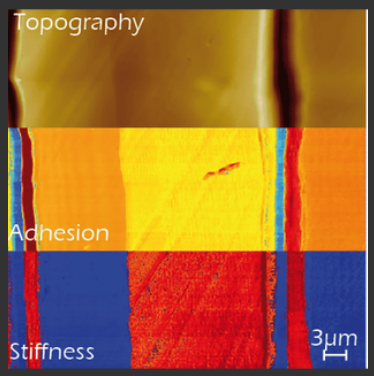
The 10µm scan of a metallic material reveals detailed surface features like grains and defects in the topography, while HD-KFM highlights variations in surface potential. This combination allows for precise analysis of both the material's structural and electrical properties



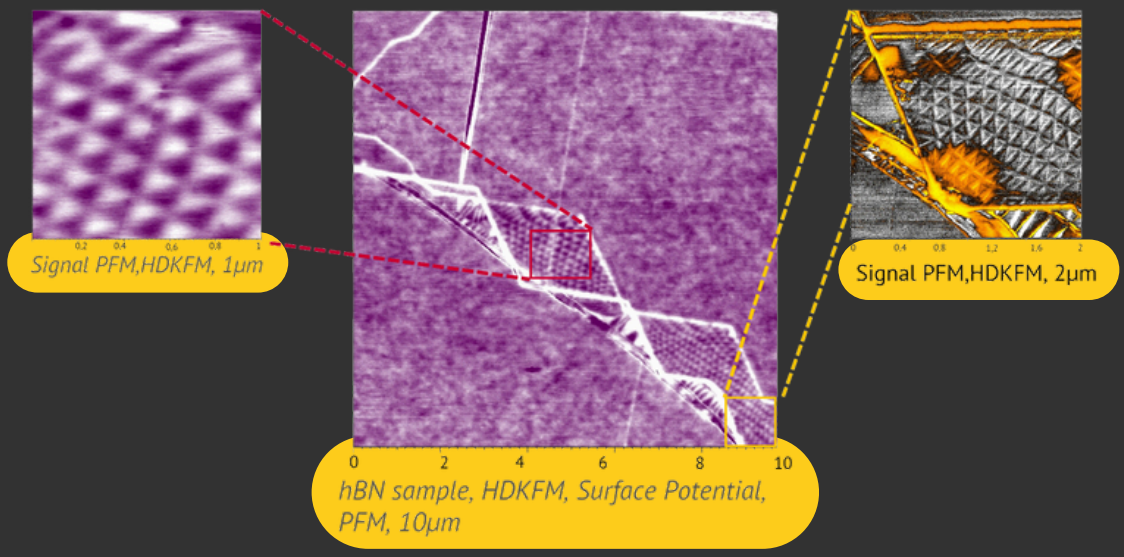
Graphene
20x20µm scan



Bio Molecules
1x1µm scan



Application field 3



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