LT ScanWave™ - Low Temp sMIM

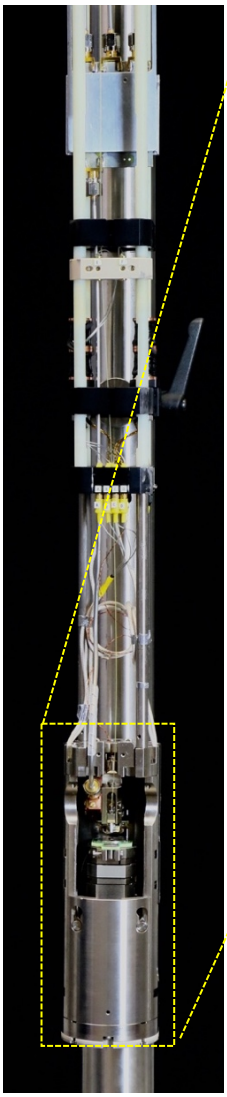
sMIM at cryogenic temperature and high magnetic field

PRIMENANO

PrimeNano's LT ScanWave™ is a Low Temp sMIM platform turnkey solution for frontier physics research (Quantum effects, Phase transitions, etc.) and novel materials studies (Topological insulators, Ferroelectrics, Manganites, etc.). This system enables electrical characterization of materials at ultra-low temperatures and high magnetic field. This complete system solution reduces researchers time to have the right equipment to get to their core research.

The standard system comes equipped with the ScanWave sMIM electronics module, optical interferometer feedback SPM insert, closed cycle cryostat, and superconducting magnet with computer controlled interface. The system can be configured to have closed loop SPM scanner, programmable closed-loop cryostat, multi-axis magnet up to 15T, and ultra-low temperature (using liquid He cryostat).

LT ScanWave™ sMIM system with Electronics control rack, closed cycle cryostat, 9T magnet and Low Temp sMIM electronics.



Left: cryostat insert with sMIM front end electronics and sMIM AFM head.

Right: Low Temp sMIM AFM with scanners, positioners and sMIM holder, sMIM matching network.

KEY FEATURES

- Measure sub-micron variations in permittivity and conductivity (ε & σ) at ultra-low temp and high B-Field.
- High stability temperature and magnetic field
- Versatile operation modes including sMIM, sMIM dC/dV, sMIM C-V spectrum for electrical properties characterization.

BENEFITS

- Commercial turnkey solution for ultra-low temp high magnetic field sMIM and SPM
- Microscopy experiments in a cryogen-free, low vibration environment
- Fast exchange of samples and/or scanning probe tips
- Compatible with different AFM modes: contact, non-contact, constant height, constant force
- Minimize sample preparation

EXAMPLE USE CASES

- Solid state physics and Quantum effects
  - Phase transitions
  - Topologic Insulators
  - Quantum Hall effect
  - Quantum Spin Hall effect
- Material science researches
  - Ferroelectrics
  - Magnates
- 1D/2D materials
  - Domain Walls
  - Graphene

Technical Specifications

General Specifications	
Technology	Scanning Microwave Impedance Microscopy (sMIM)
Cryostat	ultra-low vibration, pulse-tube based closed-cycle cryostat designed for scanning probe microscopy applications
AFM	cantilever based AFM with interferometric deflection detection
Electrical measurement	sMIM near field measurement with DC/AC bias
Cryostat Specifications*	
Temperature range	2..300K or 4..300K (depending on cryostat model)
Superconducting magnet	9T (up to 12T optional)
Sample environment	helium exchange gas
Sample exchange	top loading system for quick access
Usability	fully automated temperature and magnetic field control via integrated touchscreen, USB interface for remote control
AFM Specifications**	
Imaging modes	contact mode, non-contact mode, constant height, constant force
z feedback	PI feedback loop for amplitude modulation (AM), phase modulation (PM) or frequency modulation (FM) using included PLL
Sample positioning travel range	5 x 5 x 5 mm^3 (coarse positioning stage)
Scan size	50 x 50 x 24 μm^3 @ 300 K, 30 x 30 x 15 μm^3 @ 4 K
Measured RMS z-noise (constant force @ 4 K, 5 ms pixel time)	< 0.10 nm (expected), < 0.15 nm (guaranteed)
Insert Titanium housing diameter	48 mm
sMIM Specifications	
Measured parameters	S11, sMIM (C, R) sMIM-AC (dC/dV, dR/dV) Amp & Phase
Operation temperature	1.5..300K or 4..300K (depending on cryostat model)
RF Operation frequency	3GHz (nominal)
Probe diameter	<100 nm
Spatial resolution	100nm (depend on sample)
Electrical resolution	1 aF
Microwave power to the tip	-15dBm to -45dBm
Bias	+/-5V, DC-150kHz
Probe	Proprietary Coax Shielded probe
Compatible modes	MFM, KPFM, PFM, & c-AFM

* Integration in cooperation with attocube. Cryostat specifications based on partner verified performance
** AFM specifications based on modified attocube SPM insert from attocube