mK ScanWave™ - Ultra-Low Temp sMIM

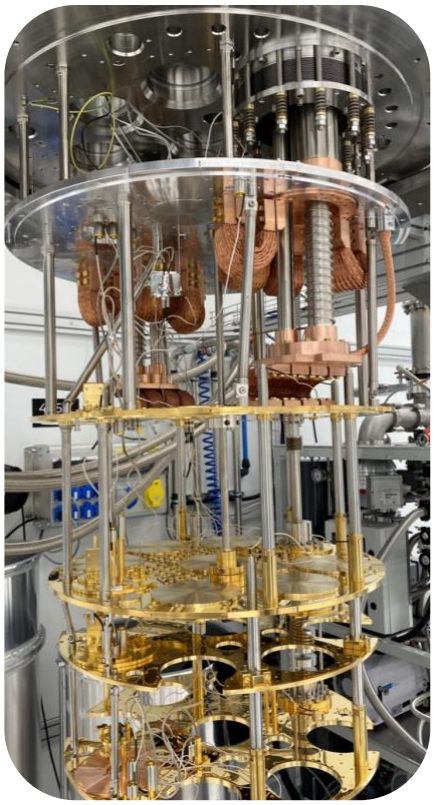
sMIM at Ultra-Low temperature (mK) and high magnetic field

PRIMENANO

PrimeNano's mK ScanWave™ is turnkey, industry robust solution. It provides an ultra-Low temperature sMIM platform turnkey solution for frontier physics research (quantum effects, phase transitions, etc.) and novel materials studies (topological insulators, ferroelectrics, manganite, 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 with the ScanWave™ sMIM electronics module, optical interferometer feedback scanning probe microscopy for sMIM at mK temperature, top loading insert for fast sample/probe exchange, closed cycle cryostat, and superconducting magnets with computer-controlled interface. The system can be configured to have closed loop SPM scanner, multi-axis magnet up to 15T, etc.

mK ScanWave™ sMIM Electronics.



Left: top loading dilution refrigerator insert.

Right: mK scanning probe microscopy with laser optical interferometer feedback.

KEY FEATURES

- Measure sub-micron variations in permittivity and conductivity (ε & σ) below 100 mK temperature and high magnetic field.
- Top loading for fast sample/probe exchange
- 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
- Fast exchange of samples and/or scanning probe tips
- Microscopy experiments in a cryogen-free, low vibration environment
- Compatible with different AFM modes: contact, non-contact, constant height, constant force
- Sub-surface measurement with high S/N ratio.

EXAMPLE USE CASES

- Quantum computing
- Solid state physics and quantum effects
  - Phase transitions
  - Topologic insulators
  - Quantum Hall effect
  - Quantum spin Hall effect
- Material science researches
  - Ferroelectrics
  - Manganites
- 1D/2D materials
  - Domain walls
  - Graphene

www.PrimeNanoInc.com *Phone: +1 (650) 300-5115* *Email: info@primenanoinc.com*

Technical Specifications

General Specifications	
Technology	Scanning Microwave Impedance Microscopy (sMIM)
Cryostat	Dilution refrigerator cryostat with ultra-low vibration, 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	0.07…300K, (depending on cryostat model and load)
Superconducting magnet	9T (up to 12T optional), or 3D magnets
Sample environment	Vacuum
Sample exchange	Top loading system for quick access
Usability	Fully automated temperature and magnetic field control, 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)	< 0.20 nm (expected), < 0.50 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	0.07…300K, (depending on cryostat model and load)
RF Operation frequency	3GHz (nominal)
Probe diameter	<100 nm
Spatial resolution	100 nm (depend on sample)
Electrical resolution	1 aF
Sub-surface sensing	Yes
Microwave power to the tip	-10dBm to -45dBm
Bias	+/-5V, DC-150kHz
Probe	Proprietary coax shielded probe
Compatible modes	MFM, KPFM, PFM, & c-AFM

* Cryostat specifications based on customized integration of sMIM insert.

** AFM specifications based on customized sMIM SPM insert model.