ScanWave Pro™

Breakthrough in Scanning Microwave Microscopy (ScanWave™)

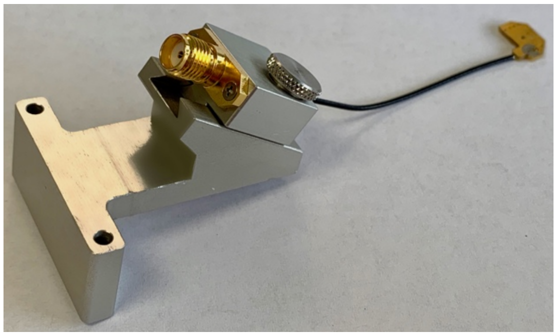
KEY FEATURES

- **More than 10X improved Signal to Noise**
- **2 orders of magnitude better doping level concentrations measurements at low doping levels**
- **Significantly improved sub-surface resolution**
- **Better overall spatial resolution images**
- **Complete electronics redesign with breakthrough sensitivity**
- **~ 7dB higher max. power output**
- **Probe module mounting and Probe improvements:**
    - **No tool probe module mounting on AFM**
    - **High Precision shielded Probes with tighter tolerances**

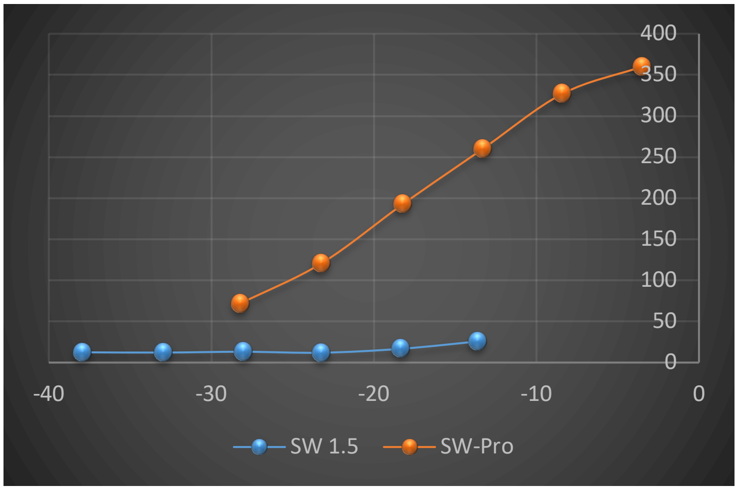
BENEFITS

- **Measure sub-micron variations in permittivity and conductivity (ε & σ)**
- **Versatile operation modes including sMIM, sMIM dC/dV, sMIM C-V spectrum for electrical properties characterization.**
- **High sensitivity measurements in AC mode and non-resonant AC mode operation such as Tapping, PeakForce tapping, Datacube etc.**
- **Initially supporting Asylum and Bruker AFMs**

ScanWave Pro™ product image



Tool less probe holder

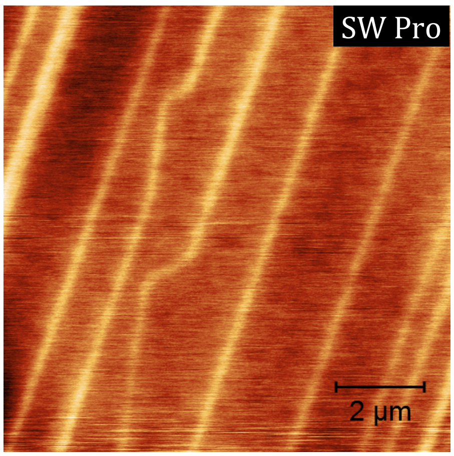


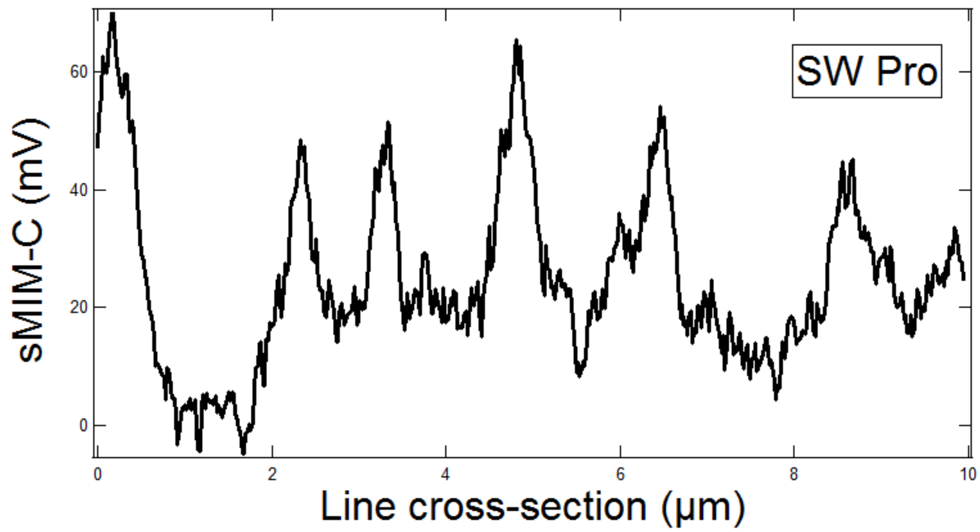
Signal to Noise comparison for ScanWave Pro™ vs ScanWave™ 1.5
Y- Axis is S/N, X-Axis is power in dBm

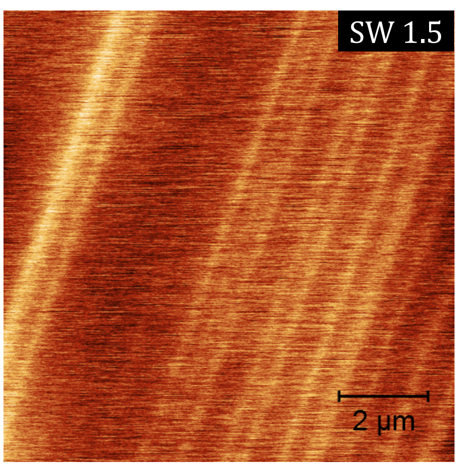
© PrimeNano 2019

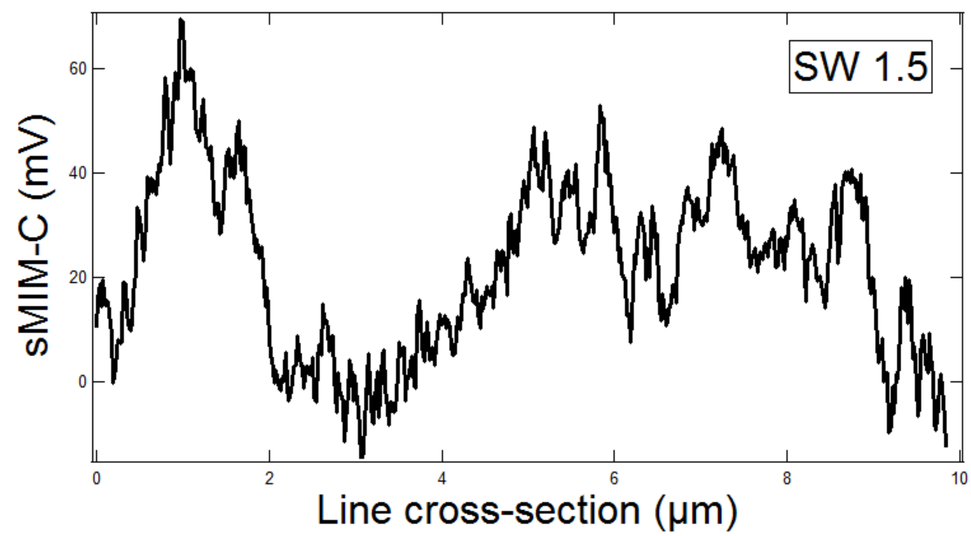
Application Examples

1. sMIM AC Mode Imaging of CNT







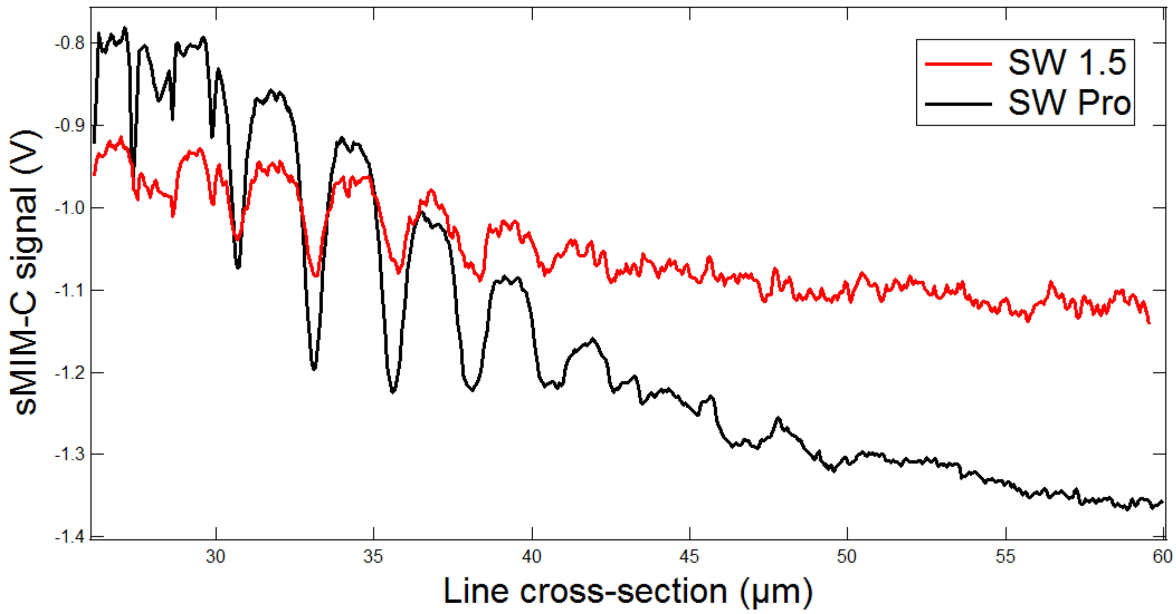


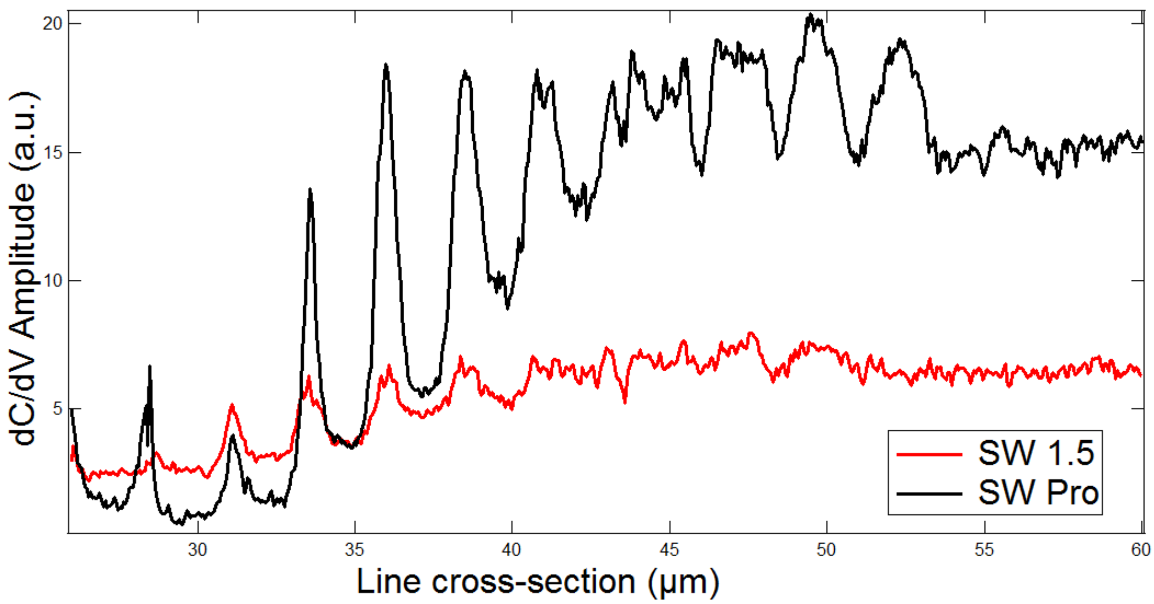
AC mode imaging of Carbon Nano Tubes (CNT) samples on sapphire:
ScanWave™ Pro shows much higher signal and lower noise comparing to ScanWave 1.5. The plots to the right of the images are single line profiles extracted from images, respectively.

ScanWave™ sMIM in AC/Tapping Mode allows imaging of fragile samples with reduced tip wear. It is limited in application often due to weak electrical signal. Enhanced performance of ScanWave™ Pro expands its field of application.

© PrimeNano 2019

2. Enhanced sensitivity to doping concentration

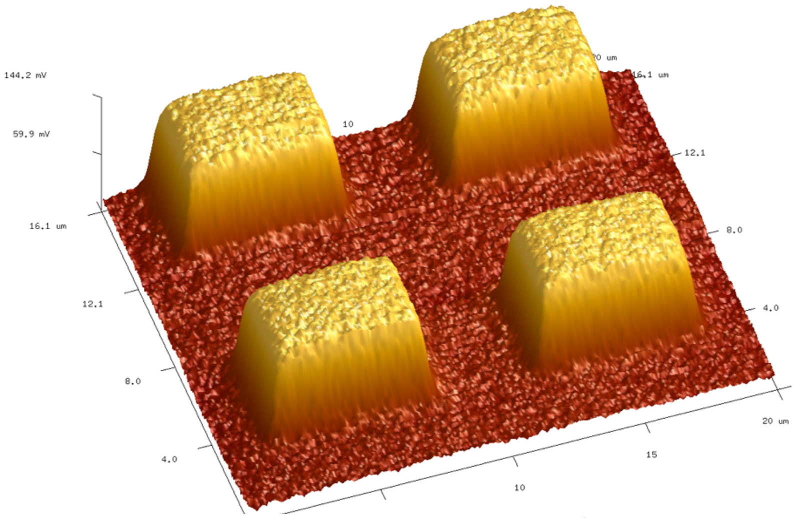




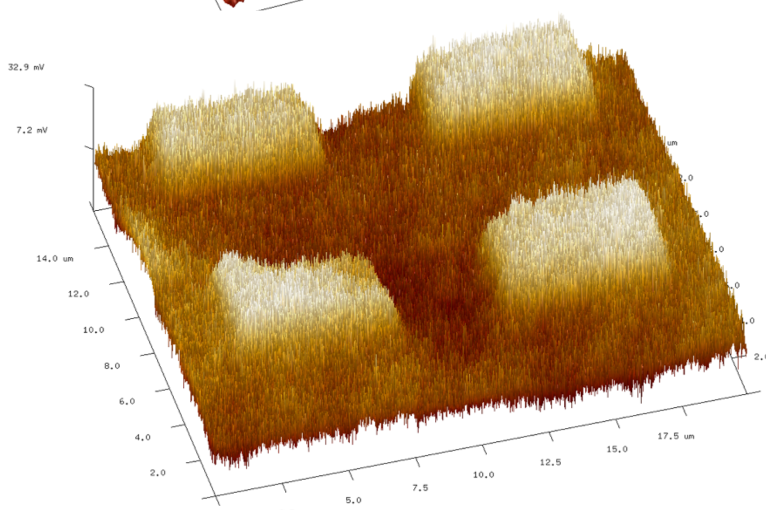
sMIM-C (Top) and sMIM dC/dV amplitude (bottom) of p/n doped standard staircase sample by Infineon, measured using ScanWave™ Pro and ScanWave™ 1.5 respectively. The line cross-sections shown above are across the P-doped region with the dopant concentration reducing from left to right. Both diagrams show a significant increase in ability to distinguish the different carrier density with ScanWave Pro, particularly at low doping concentrations.

© PrimeNano 2019

3. **Higher Quality Subsurface Imaging**



ScanWave™ Pro



ScanWave™ 1.5

sMIM-C images of SiO_2 structure buried beneath 190nm of SiN. (A) with ScanWave™ Pro at -2dBm power and (B) with ScanWave™ 1.5 at -17dBm power. The higher power and sensitivity of ScanWave™ Pro improves the SNR, resulting in greatly improved capability of detecting deeper buried sub-surface features or samples which give less sMIM-C signal.

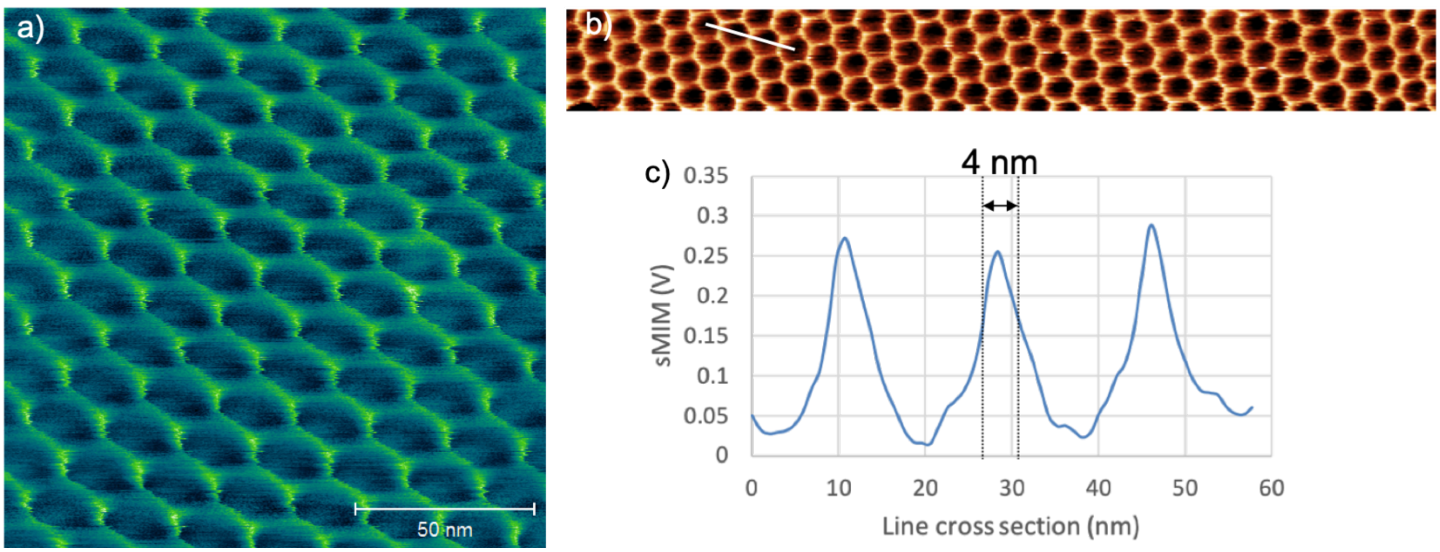
ScanWave™ Pro offers greatly improved capability for sub-surface imaging compared to ScanWave™ 1.5. SiO_2 islands with their top surface buried under a 190nm of SiN layer are easily detected using the Pro system. While using the ScanWave™ 1.5, it is more challenging to accurately identify feature edges, even at its best operating conditions. In fact, ScanWave™ Pro, when operated with its lowest SNR operating condition gives similar image quality as ScanWave™ 1.5 does at its best operating condition. With higher microwave output power and greatly improved signal detection capability of Pro the measurement of buried structures is significantly improved and much easier with ScanWave™ Pro compared to ScanWave™ 1.5.

© PrimeNano 2019

4. Moiré pattern of Graphene on hexagonal Boron Nitride

When two different regular patterns are superimposed, a new pattern emerges with larger periodicity, called moiré pattern. The combination of atomically thin graphene and boron nitride (h-BN) layer at a slightly rotated angle results in a well-defined moiré pattern and also changes in their electronic properties. The periodicity of the pattern depends on the twist angle between graphene and h-BN.

The figure below shows the capabilities sMIM using ScanWave™ Pro to image the Moiré pattern in contact mode. While there is no contrast in the topography (not shown), the contrast in the sMIM signal shows the honeycomb pattern with a period of 17-18 nm (Figure a, b). A line cross section (Figure c) indicates sharp transition in the honeycomb pattern with ~4 nm lateral spatial resolution (FWHM).



© PrimeNano 2019