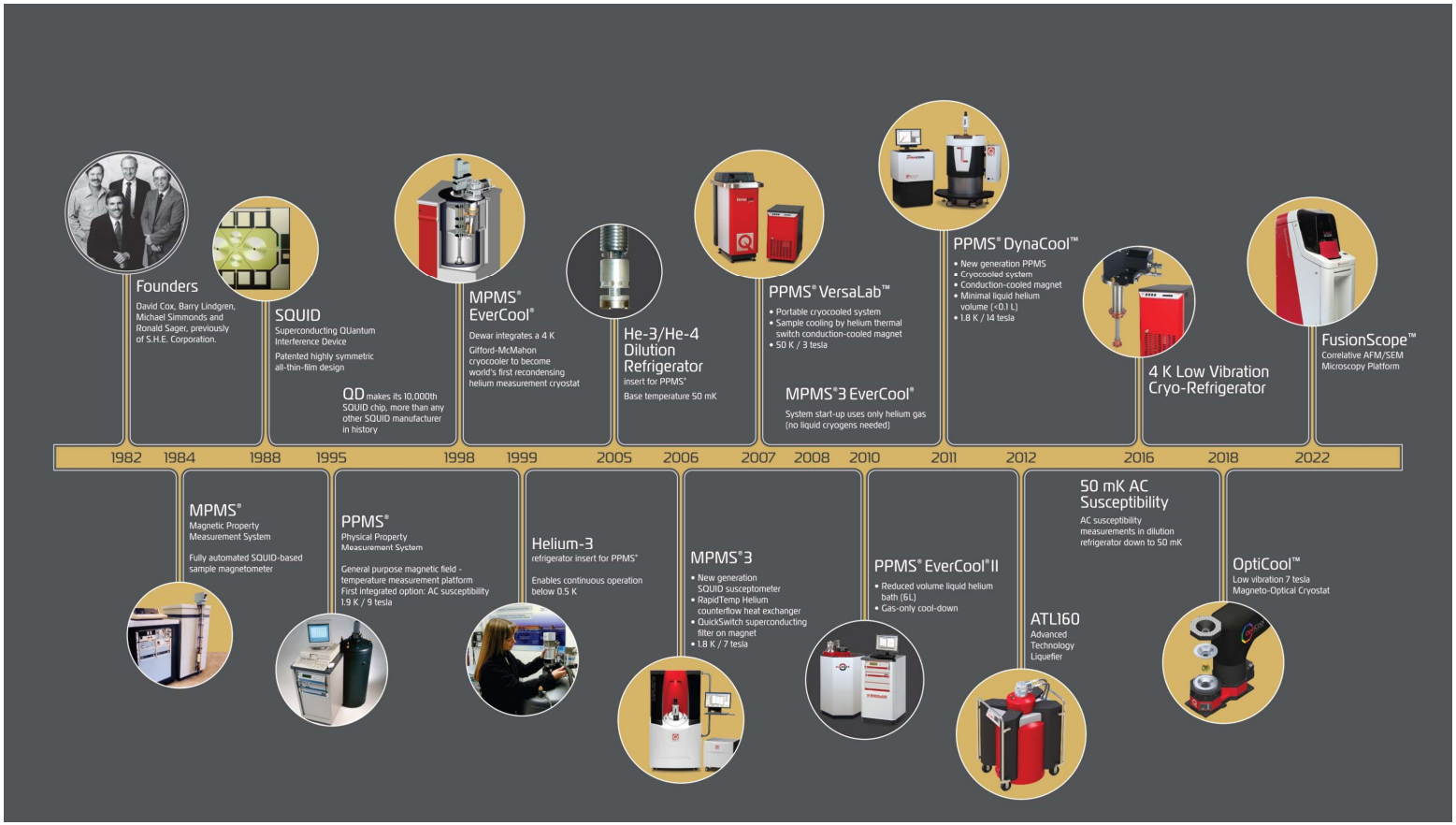
Quantum Design

Lab Ready Instruments

Darius Choksy
Application Scientist

The Quantum Design Timeline



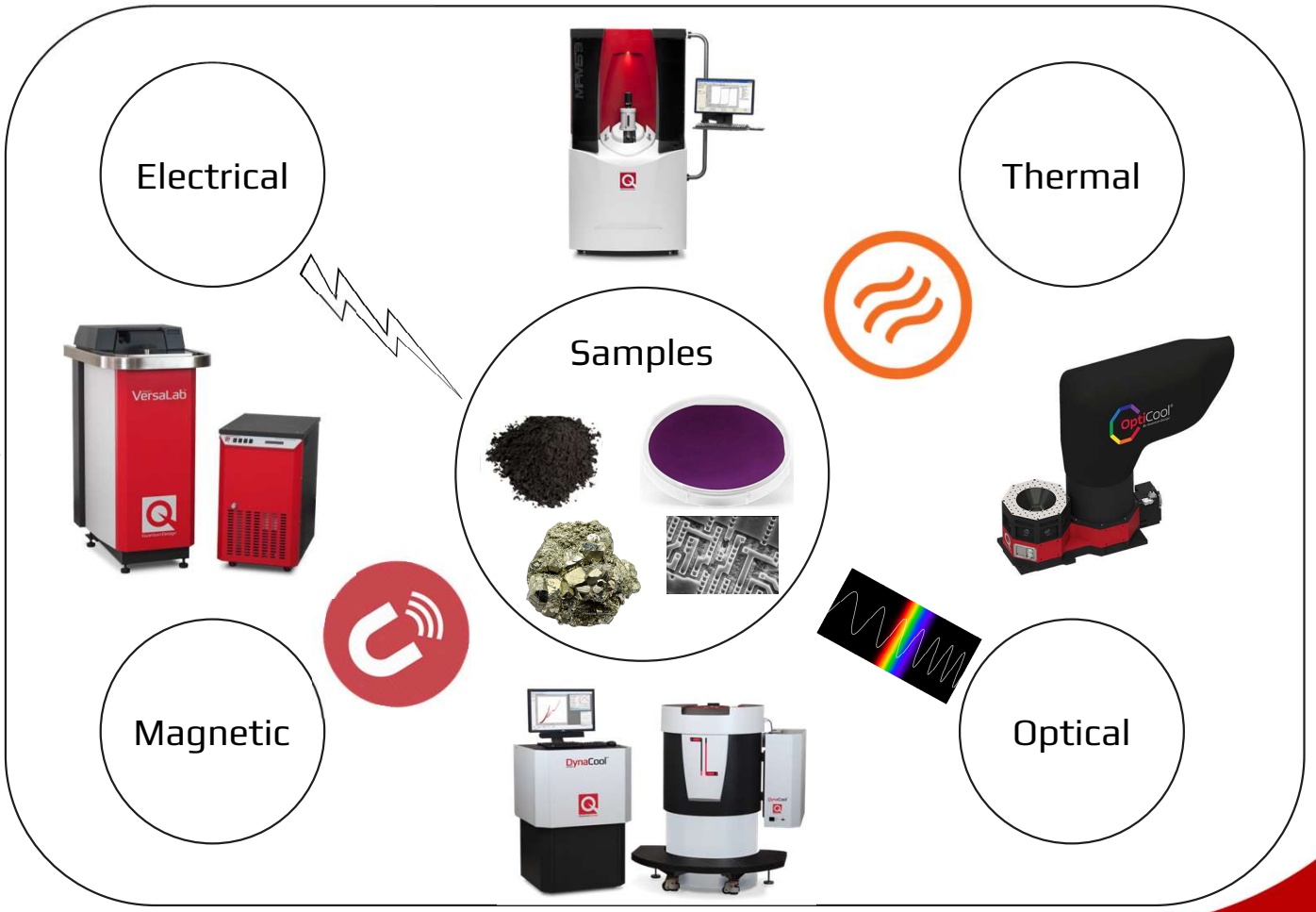
Quantum Design

Environments

Temperature

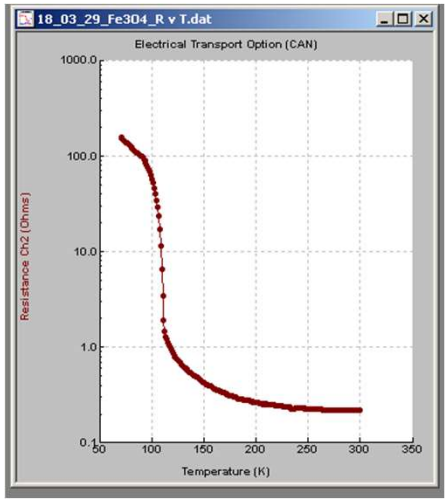
Magnetic Field

Pressure

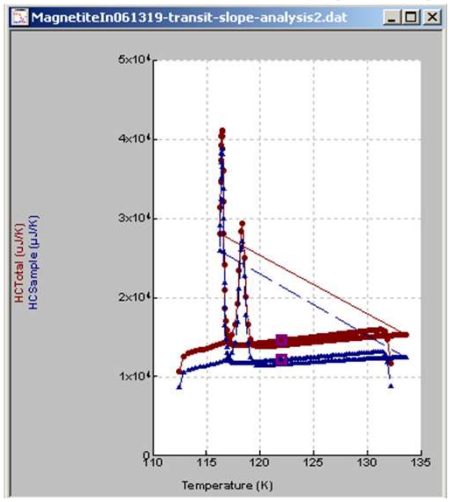


Correlated Measurements: Magnetite

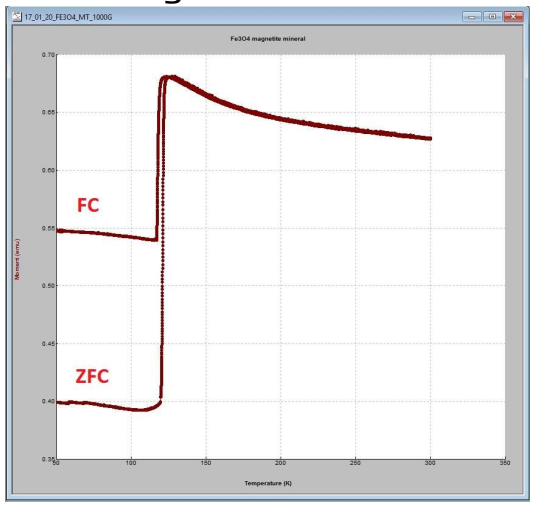
Electrical: Resistance



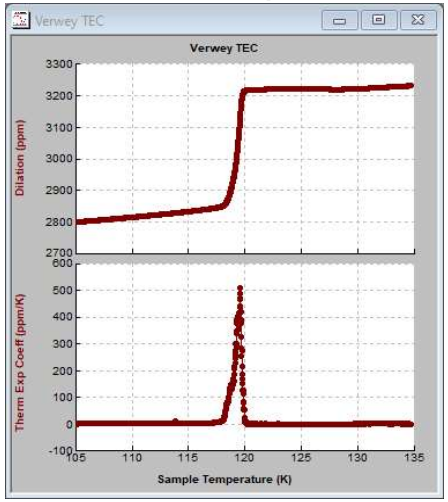
Thermal: Heat Capacity

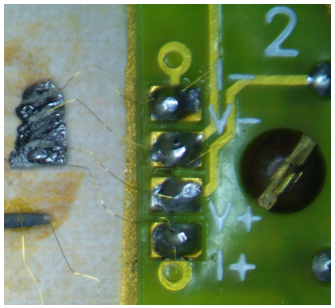


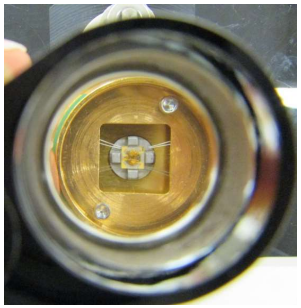
Magnetic: Moment

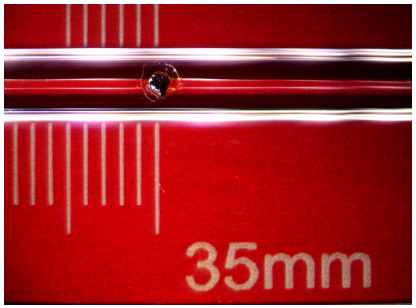


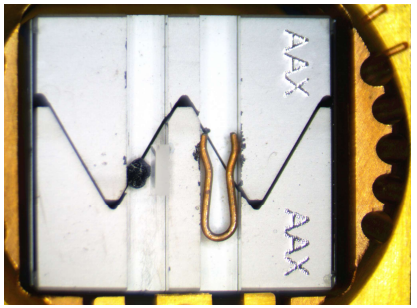
Thermal: Expansion



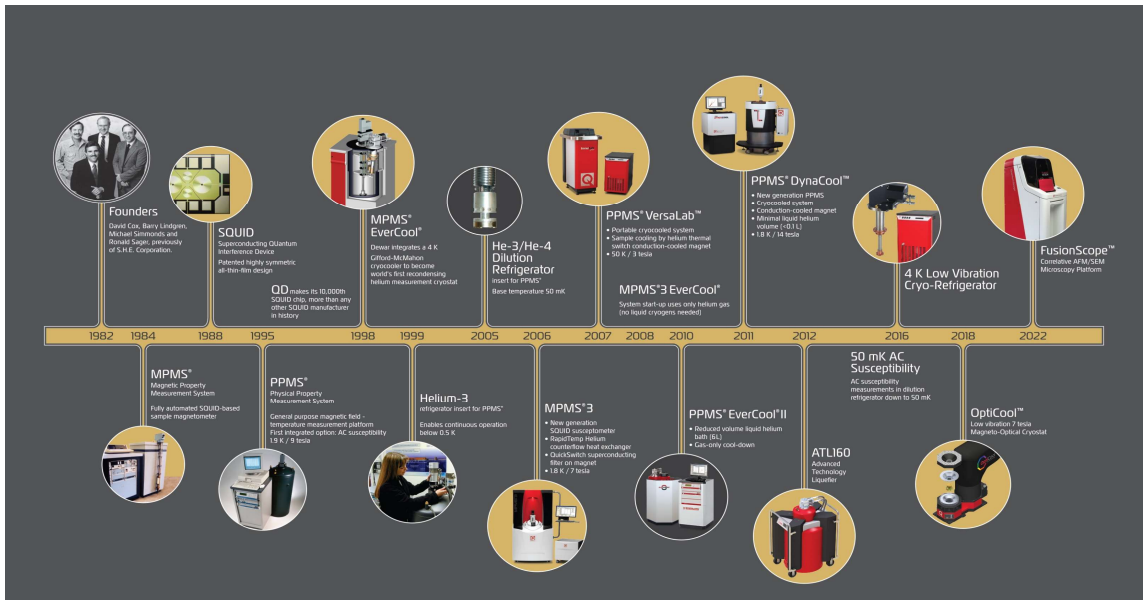








Magnetic Property Measurement System (MPMS)



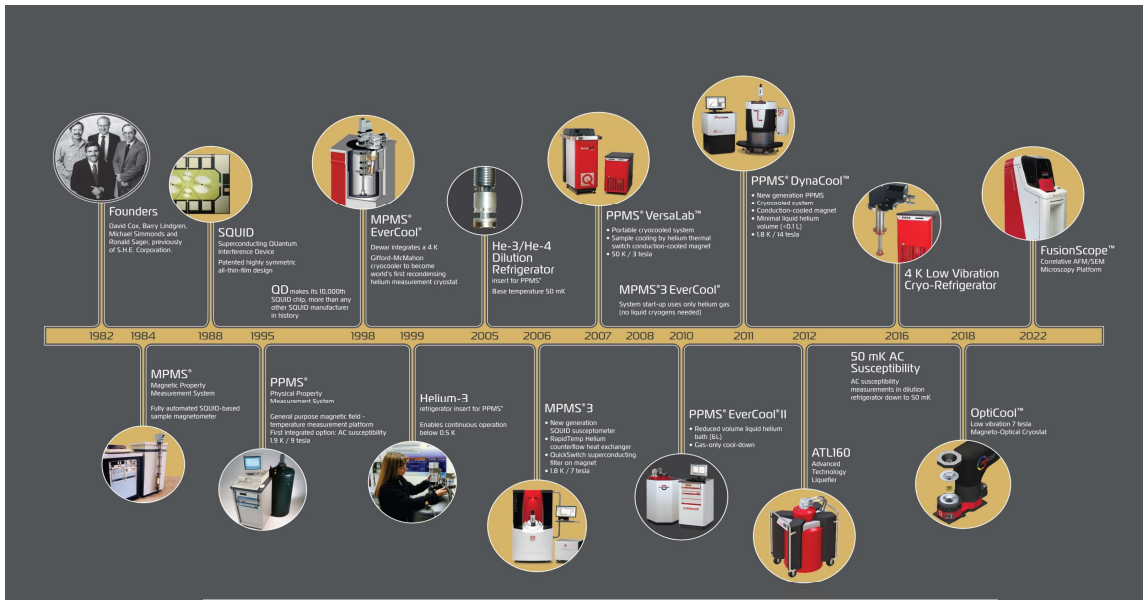
2006

MPMS®3

MPMS3

- 1.8 – 400 K temperature range
- 7 T magnetic field
- Cryogen free
- Most sensitive commercial magnetometer
- Sensitivity < 1 x 10^{-8} emu (≤ 2,500 Oe), < 8 x 10^{-8} emu (> 2,500 Oe)
- Capable of multiple scan mode:
  - DC Scan
  - VSM mode
  - AC Susceptibility

Physical Property Measurement System (PPMS)



2011

DynaCool™
PPMS®

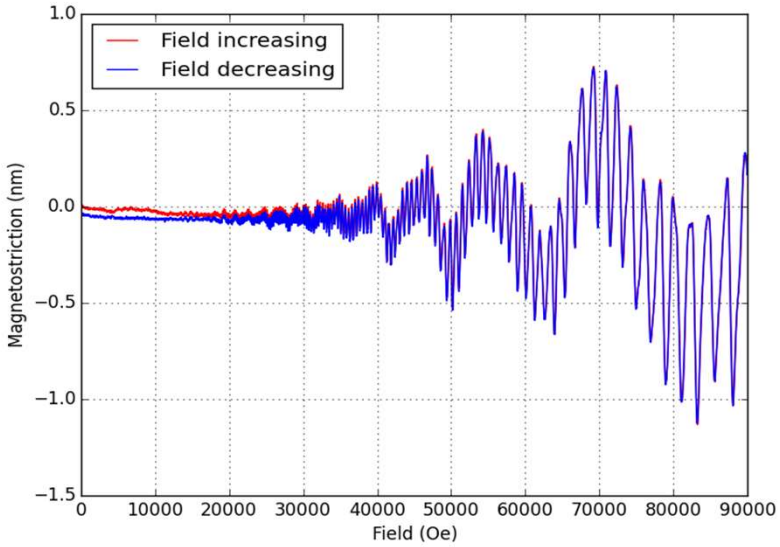
0.05 K Minimum Temperature with DR
9, 12, 14 Tesla Field
Complete Suite of Measurement Options

DynaCool™ PPMS®

- 1.8 – 400 K temperature range
- 9, 12, 14 T magnetic field options
- Cryogen free
- Measurement options involving electrical transport, thermal measurements, and magnetometry

DilatoMeter

- Measure thermal expansion and magnetostriction
- Resolution < 20 pm at 2 K
- Can see transition in thermal expansion
- Can study asymmetries in magnetostriction to determine crystal lattice properties



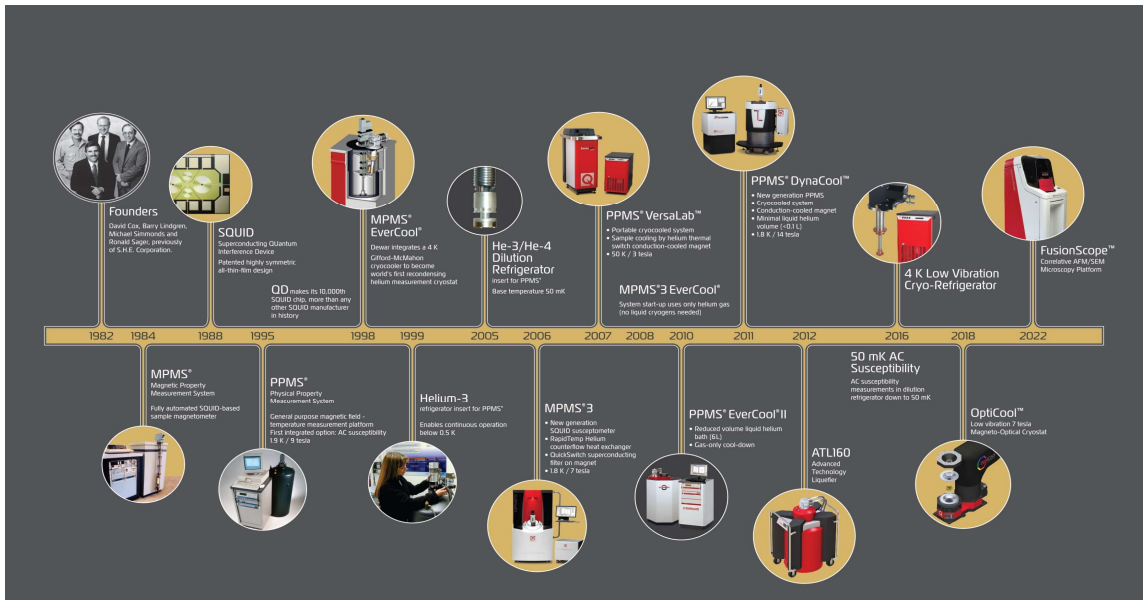
Inserts

LakeShore M81

He-3 and Dilution Refrigerator

Optical Multi-Function Probe

OptiCool



2018

OptiCool®
By Quantum Design

OptiCool®
By Quantum Design

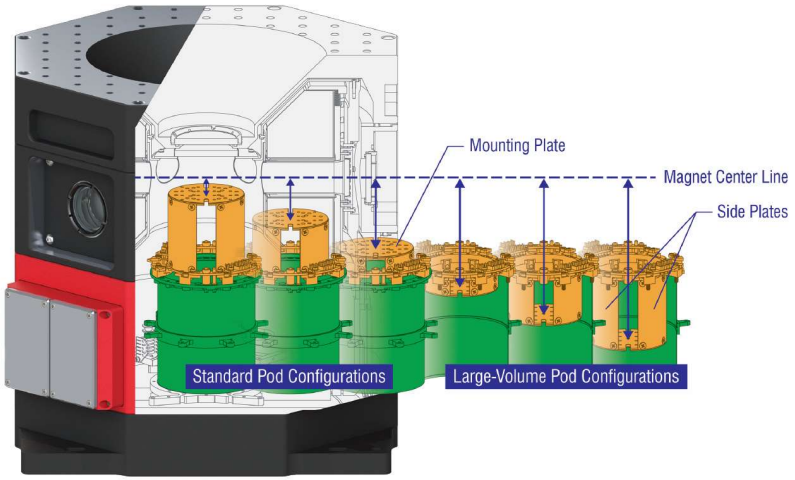
- 1.7 – 350 K temperature range
- 7 T magnetic field or
- 4:1:1 T Vector magnet
- Side and top optical access
- Cryogen free
- Low vibrations:

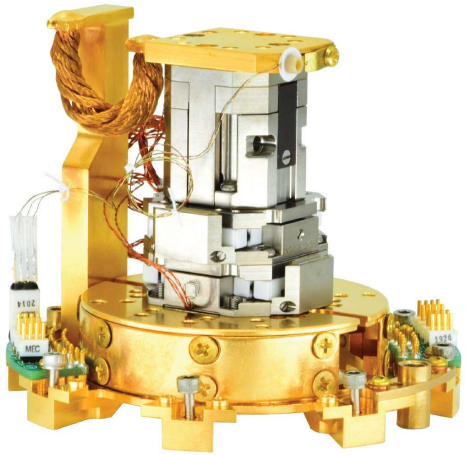
< 10 nm in x and y
< 4 nm in z

- Large available sample volume allows users to build up their experiments

- Window options:
  - Low working distance top (3 mm)
  - Vacuum objective mounting hardware
  - Bottom window for transmission

- Customizable wiring options
  - DC feedthroughs
  - RF feedthroughs
  - Nano positioner Feedthroughs
  - Optical Fiber Feedthroughs





SNOM measurements in OptiCool

- Far field diffraction limit $d = \lambda/(2n \sin\theta)$
- Resolution is limited by wavelength
- Scanning near-field optical microscopy (SNOM) allows for resolution below the diffraction limit
- Evanescent fields is an oscillating field that does not propagated as a wave, but is concentrated near a source
- Evanescent field is created by light interacting with sharp feature $\ll\lambda$

nature nanotechnology

Article

https://doi.org/10.1038/s41565-023-01488-y

Infrared nano-imaging of Dirac magnetoexcitons in graphene

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Check for updates

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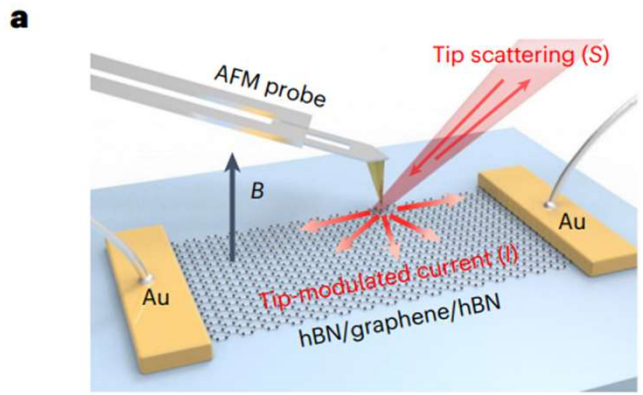
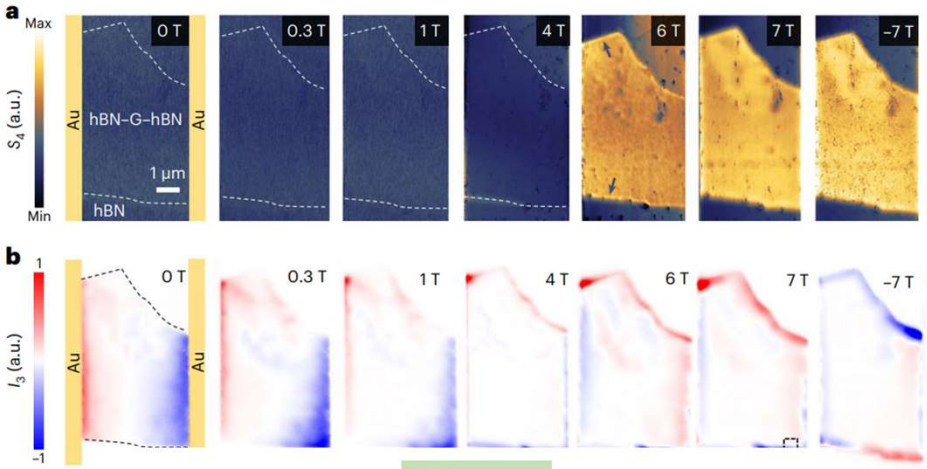
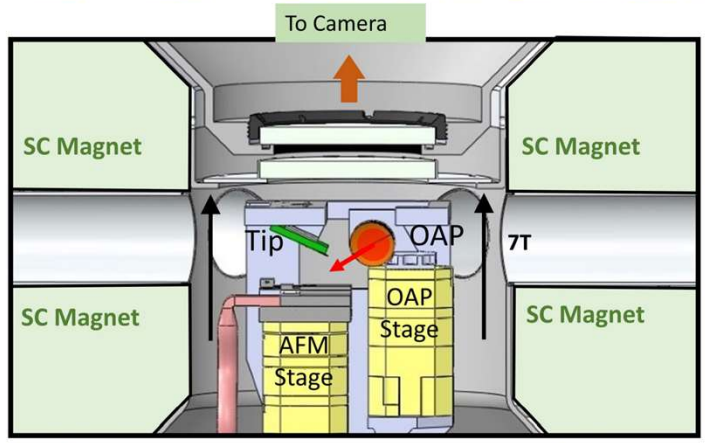


SNOM measurements in OptiCool

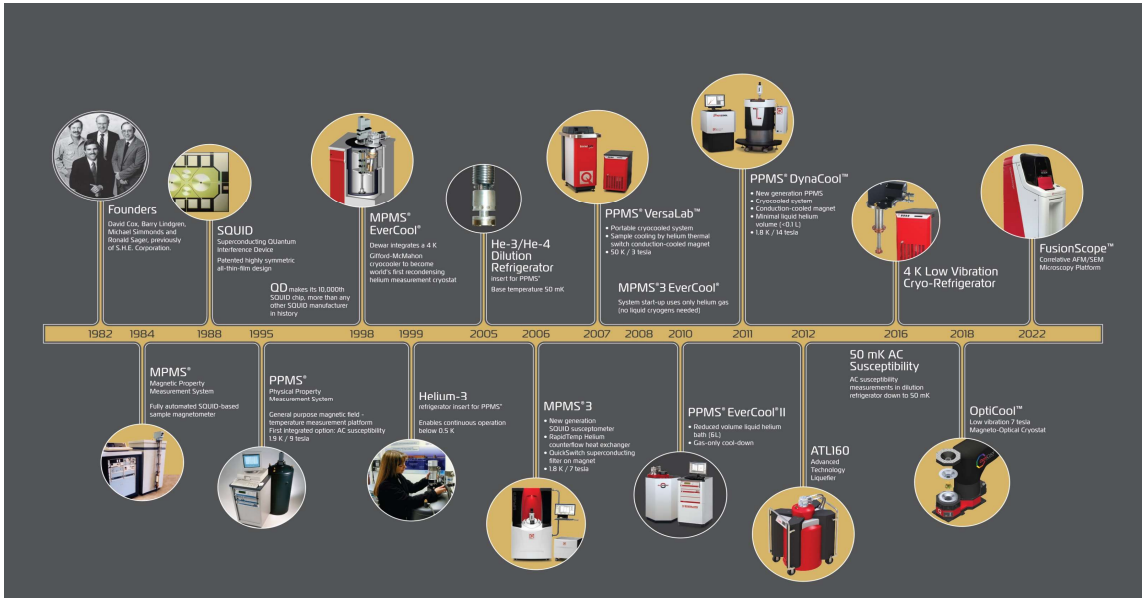
- OptiCool provides a platform for magneto scanning near-field optical microscopy m-SNOM
- Allows for the visualization of the magneto optical effects
- This paper directly visualizes Dirac magnetoexcitons in graphene and associated photocurrent

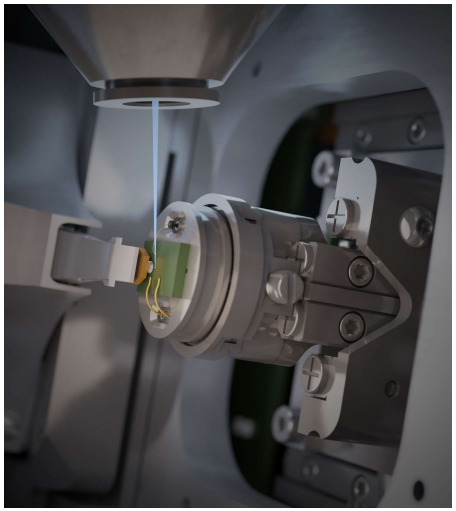




Extended Data Fig. 1 | Closed-cycle m-SNOM setup. OAP: off-axis parabolic mirror. Tip: Akiyama probe. Light enters the chamber in the horizontal direction (into the field of view) and is focused onto the sample with an OAP.

FusionScope





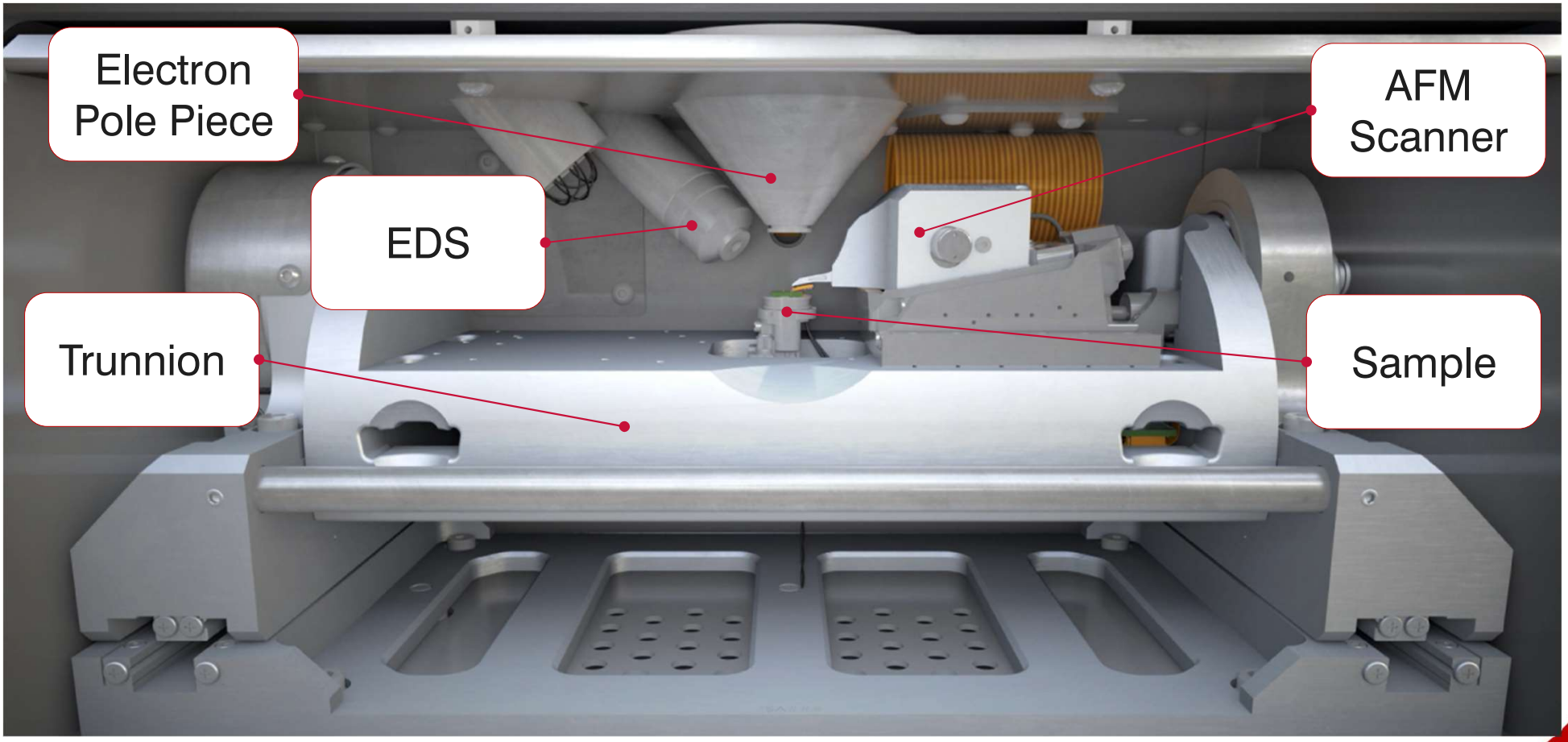
2022

fusion scope™ by Quantum Design

Correlative Microscopy Platform

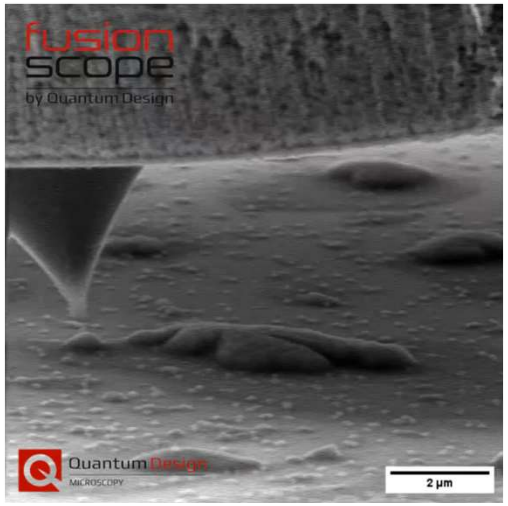
Topography/Conduction/Magnetic/Elemental...

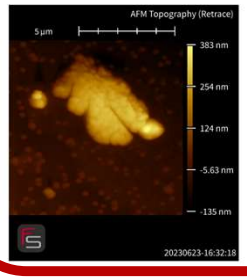
The FusionScope – A Unique Correlative Analysis Platform

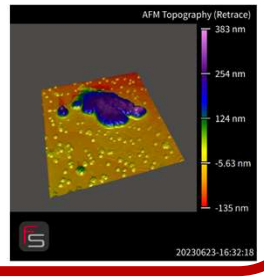


AFM with SEM

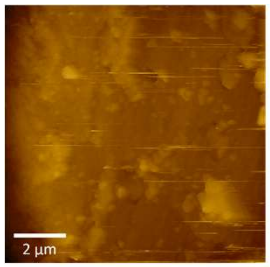
Observe cantilever Tip during AFM operation

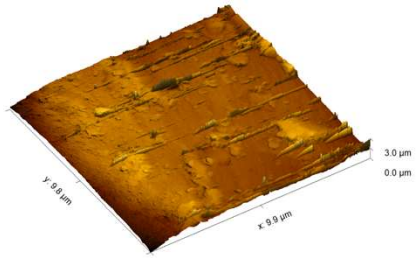


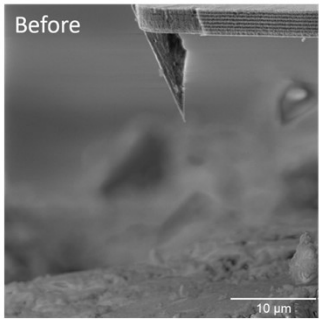


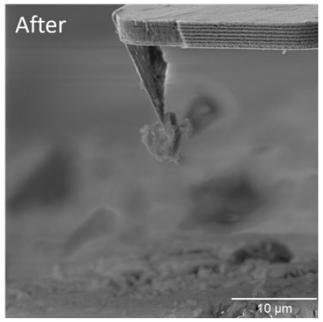


Evaluate Tip Quality in real time

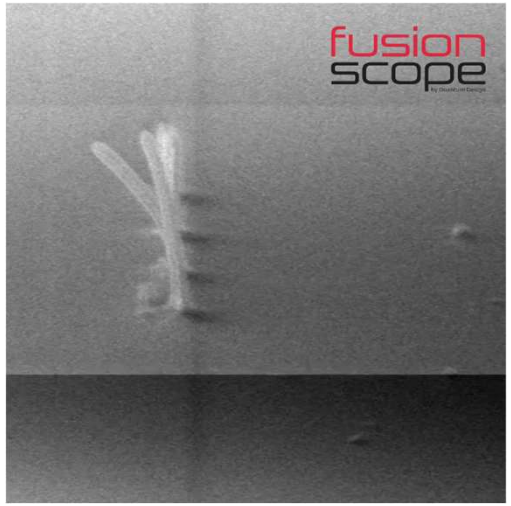


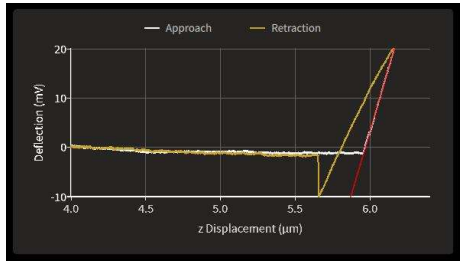




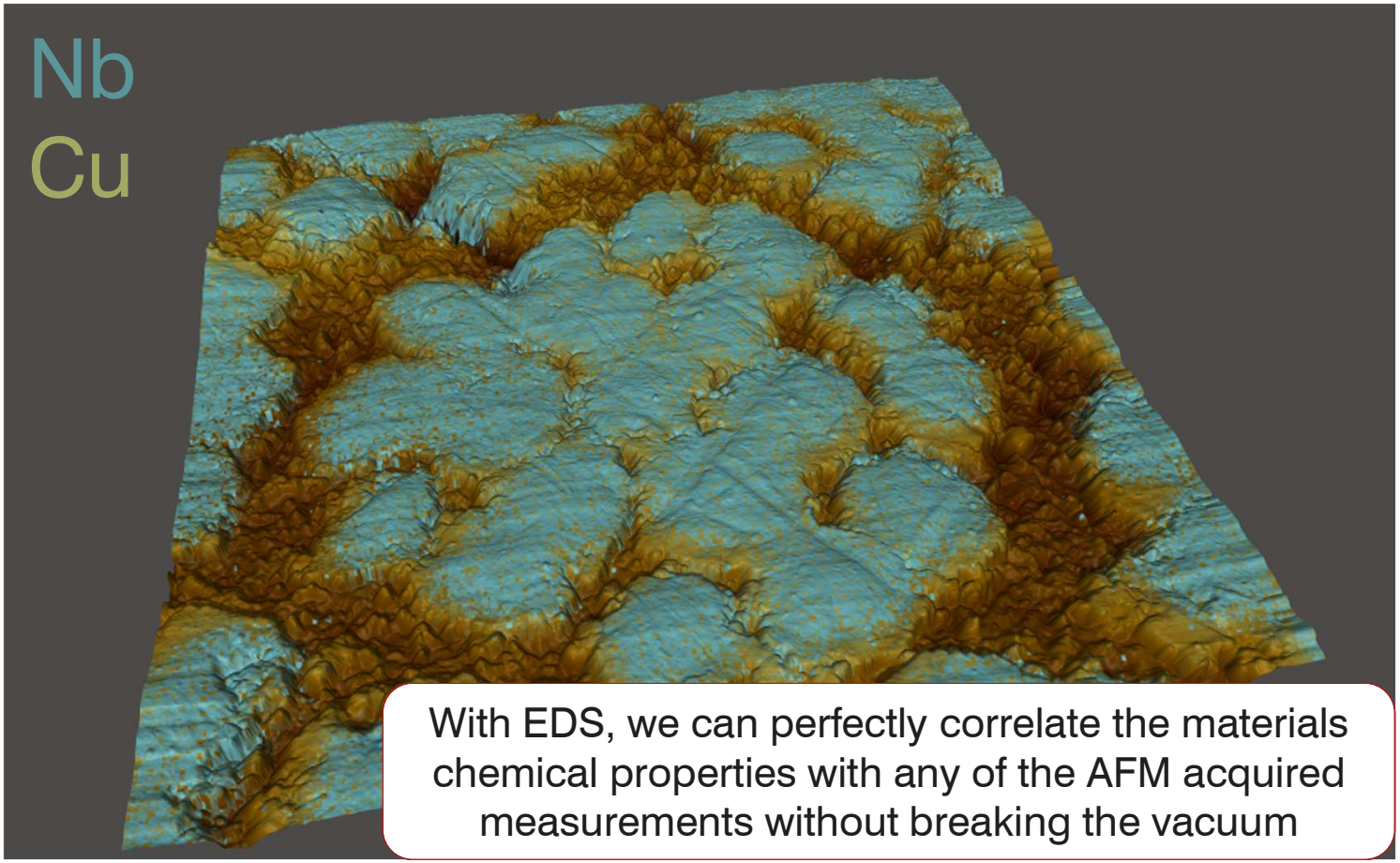


Navigate Tip precisely & controllably onto Nano-objects





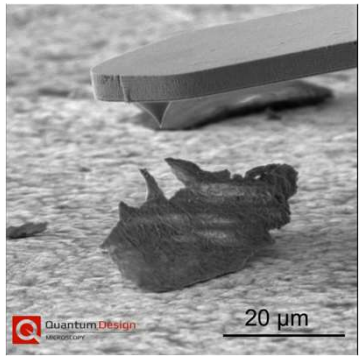
AFM with EDS



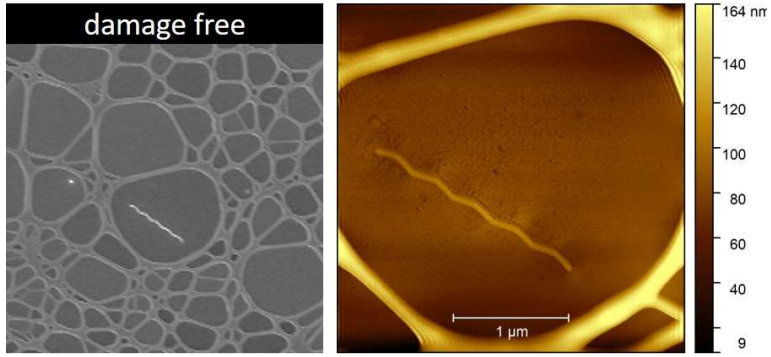
With EDS, we can perfectly correlate the materials chemical properties with any of the AFM acquired measurements without breaking the vacuum

A different approach to measurements

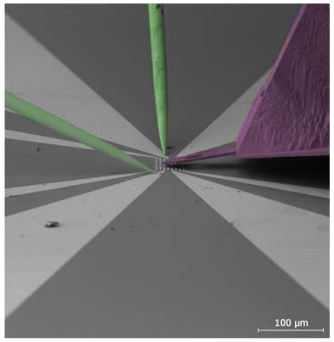
Analysis of force distance curves

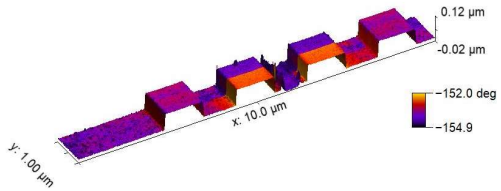


Precise control and placement of AFM tip

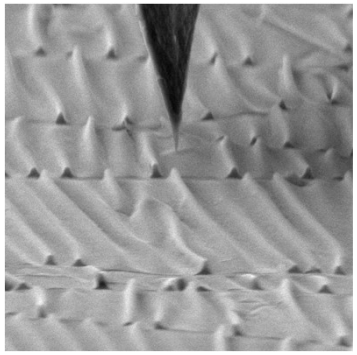


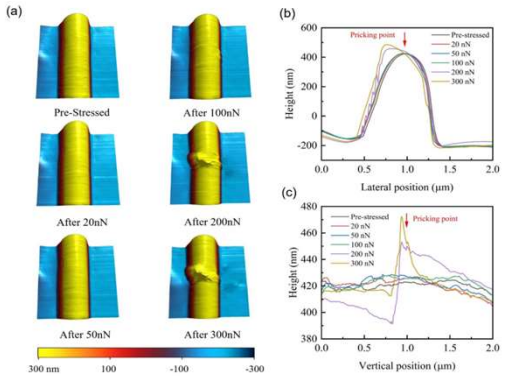
Nanoprobes for manipulation and biasing





Locate and measure wrinkles in 2D materials





Ye et al., *Self-Restoration of a Wrinkled $Hf_{0.5}Zr_{0.5}O_2$ Ferroelectric Membrane*, ACS Applied Materials & Interfaces, 2025

Quantum Design