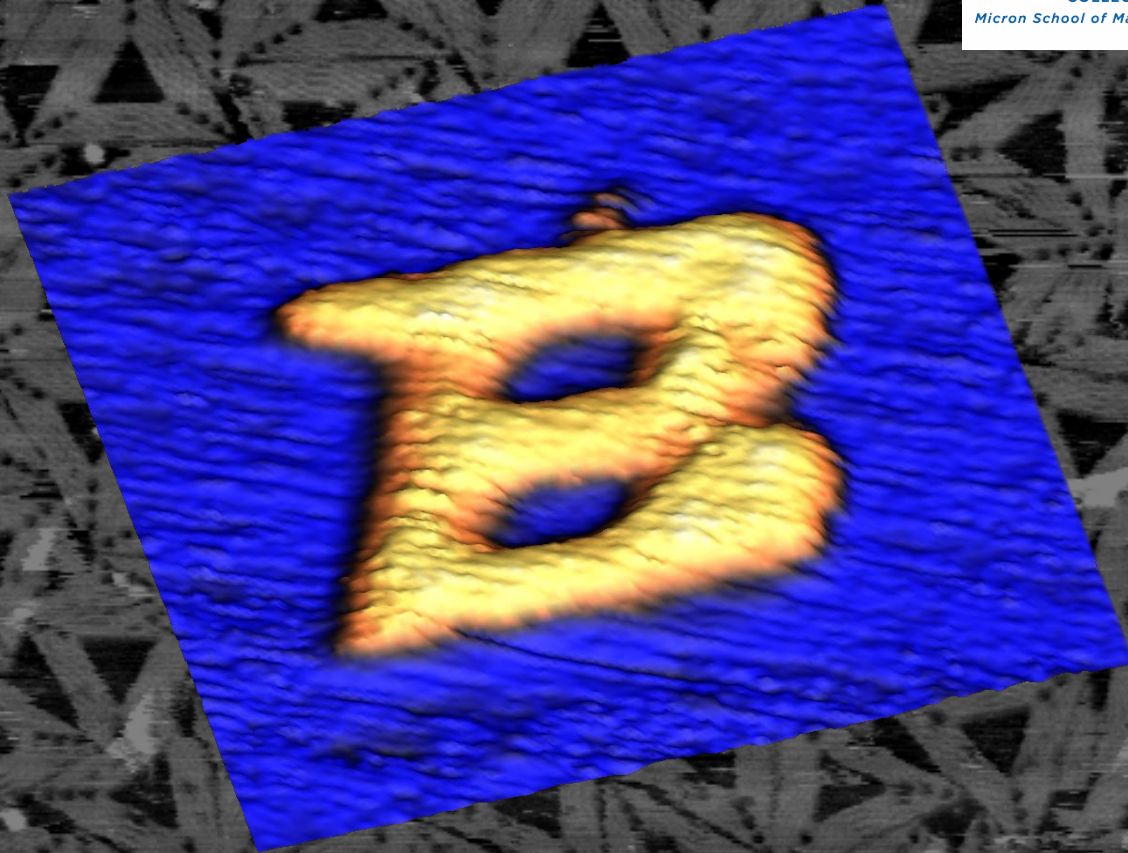




**BOISE STATE UNIVERSITY**

COLLEGE OF ENGINEERING

*Micron School of Materials Science and Engineering*



**Surface Science Lab**

# Characterization Tools

- **Atomic Force Microscopy (AFM)**

- Bruker Dimension Icon FastScan with Nanoscope V Controller
- Bruker MultiMode 8 with Nanoscope V Controller
- Bruker Dimension 3100 with Hysitron TS 75 TriboScope Nanoindenter

- **Scanning Electron Microscopy (SEM)**

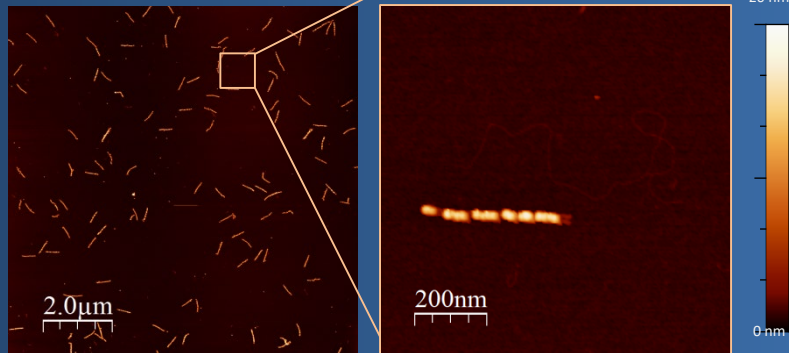
- FEI Phenom tabletop SEM



## AFM Modes/Capabilities

### Sample Topography/Surface Roughness

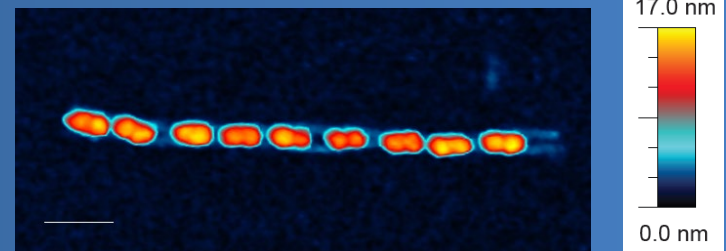
Multiple high speed (>10 Hz), low force imaging modes are available to minimize sample degradation. FastScan's programmable stage movement enables automated acquisition of overlapping high lateral resolution (down to 1-2 nm), large area (up to 35  $\mu\text{m}$  x 35  $\mu\text{m}$ ) scans. Multisample and 8" wafer sample chucks are available.



Noncontact Tapping mode images of gold nanoparticle decorated DNA nanotubes. Image at right is a zoom of the larger image.

### Nanomechanical Properties Mapping

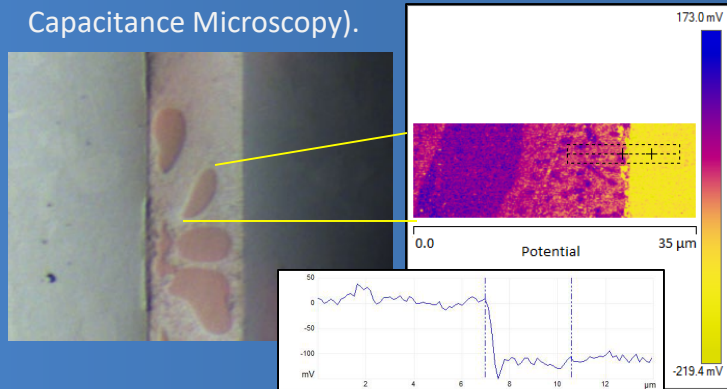
PeakForce Tapping mode permits simultaneous acquisition of high resolution sample topography images (20-40 pm noise floor) and determination of nanomechanical properties (adhesion, deformation, dissipation, Young's modulus) via rapid (>1 kHz) force curve acquisition. To minimize tip wear and sample damage, <1 nN peak forces are routinely used on soft or fragile samples (e.g., DNA, device structures).



PeakForce Tapping mode image of a ladder-like DNA nanotube structure bridged by gold nanoparticle pairs. Such structures are of interest for plasmonic waveguide applications.

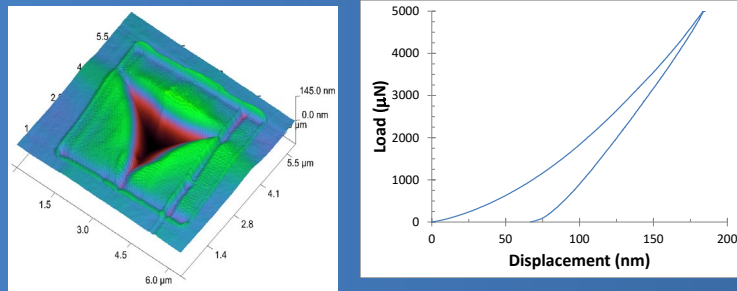
## Electrical Properties Mapping

TUNA (Tunneling AFM) module permits conductivity measurements ranging from 50 fA to 1  $\mu$ A. Kelvin Probe Force Microscopy (KPFM) enables measurement of surface potential/work function with tens of nm/mV resolution. Dopant profiling possible via SCM (Scanning Capacitance Microscopy).



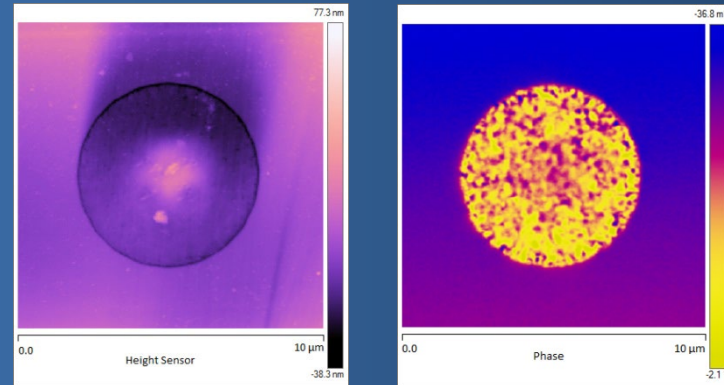
## Nanoindentation

Hysitron TriboScope can perform indents in either depth or load (up to 25 mN) control to reveal a sample's nanoscale depth-dependent modulus and hardness.

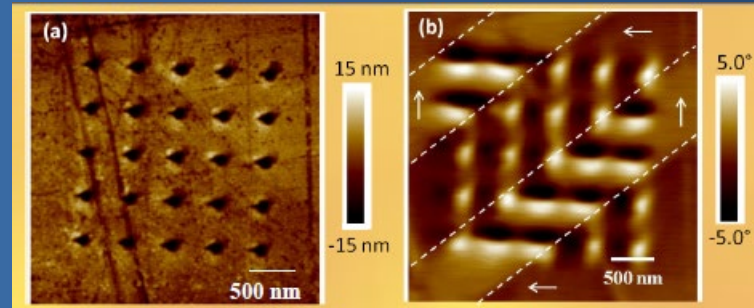


## Magnetic Force Microscopy (MFM)

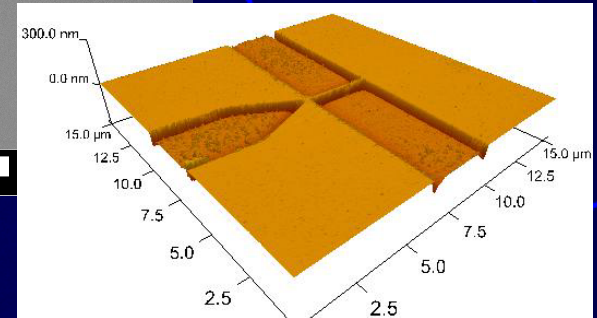
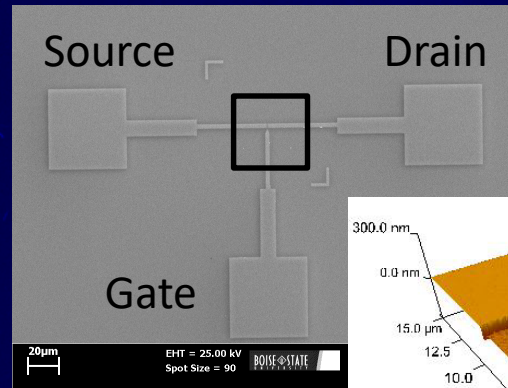
Imaging of magnetic domain orientation. Heater/cooler stages (-35°C to +250°C) enable monitoring changes in magnetic properties with temperature/crystalline phase.



Topography (left) and magnetic phase (right) images of a Ni-Mn-Ga ferromagnetic shape memory alloy nanopillar.



Topography (left) and magnetic phase (right) images of a Ni-Mn-Ga nanoindentation array. Dotted lines indicate twin boundaries; arrows indicate magnetization direction.



**Contact Information:**

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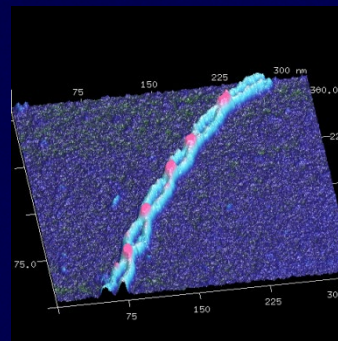
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SEM (upper left) and AFM (lower right) images of a novel biotransistor platform. Black box in the center of the SEM image indicates the area of interest in the AFM image.



Left: Twisted DNA nanotube pair created via dye intercalation.

Front cover: DNA origami. BSU logo (foreground) and aggregated triangles (background).