Actoprobe
AFM Instruments

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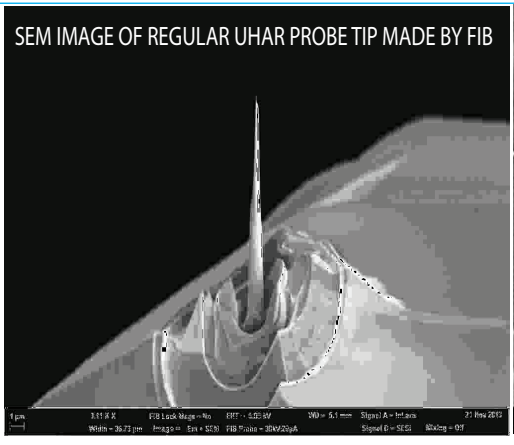
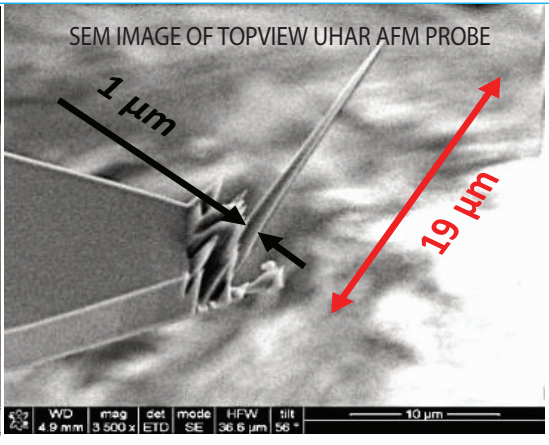
UHAR AND NSOM AFM PROBES





UHAR AFM probes are modified from regular AFM probes by Focused Ion Beam (FIB) milling to achieve a probe tip length of more than 6 µm.

Regular UHAR AFM probes require imaging from oblique direction, while topview UHAR AFM probes allow imaging from vertical direction.

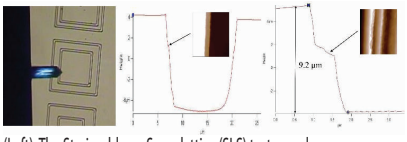
Features:

- Tip length up to 13 µm usable scanning length, tip radius of curvature < 6nm, tip aperture < 7°
- Allowing for ultra-deep (6-10 µm) trench imaging
- Attaining higher quality imaging of extremely steep (>85°) sidewalls
- Creating much more detailed height imaging profiles
- Ascertaining to a higher degree the etch effects on deep trench sidewalls
- Probe Material: Si or GaAs
- Different Metal coatings on the tip: Au, Ag, Pt.

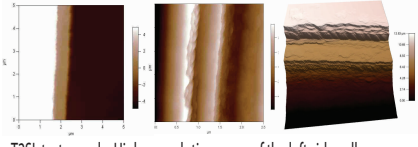
Applications:

- Sidewall characterization for small pixel infrared Focal-place Array (FPA) detectors
- MEMS
- Biological samples.

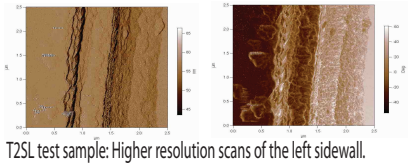
NSOM AFM probe is made of silicon, with two apertures (openings), one on the top and one on the bottom. Visible laser light can be coupled into the probe.



(Left): The Strained-layer Superlattice (SLS) test sample with the AFM tip as seen through an optical microscope.
(Center): Height profile of a 28-µm scan that shows the entire trench
(Right): Height profile of a 5-µm scan in higher resolution.
The inserts show the corresponding AFM topography images.

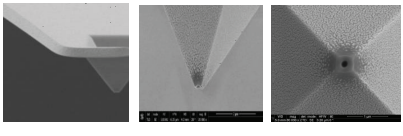


T2SL test sample: Higher resolution scans of the left sidewall. The 5 µm topography scan (Left) shows the step at ~3.4 µm below the top. The 2.5 µm scan (Center) shows the step in more detail, but the height scale is tilted due to attenuating. (Right) 3D image of the left sidewall with a correct height scale.



T2SL test sample: Higher resolution scans of the left sidewall. Amplitude (Left) and Phase map (Right)

SEM IMAGES OF THE NSOM AFM PROBE



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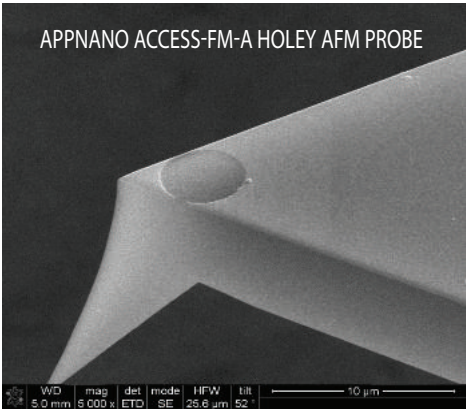
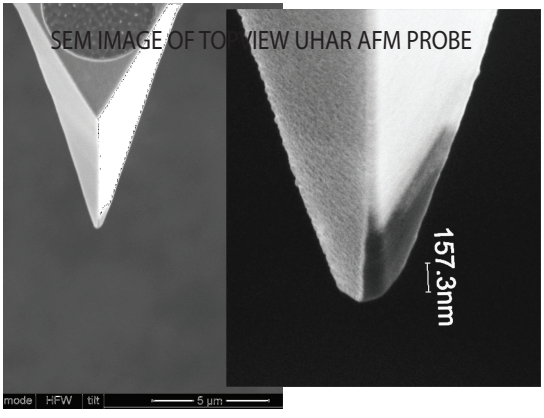
HOLEY AFM PROBES





Holey AFM probes are modified AFM probes with metal coating selectively removed above the tip on the cantilever to allow coupling of external laser source into the back of the tip.

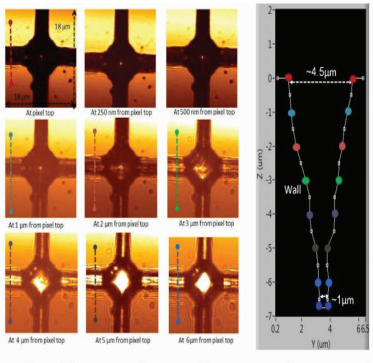
Typically, a NIR (1.3 µm) diode laser can be used to couple light into the holey AFM probe made of silicon. The AFM tip works as a total internal reflection conical prism. Without coating/aperture, light can be focused at the probe apex to a dimension of λ/2n. With the commercial AFM tip coated with ~50 nm of gold, the light can be focused into a spot of ~20nm theoretically.

Features:

- Combining AFM imaging with Near-field Scanning Optical Microscopy (NSOM) and spectroscopy
- Sub-micron lateral optical resolution
- Upright collection of the signal
- Different Metal coatings on the tip: Au, Ag, Pt.

Applications:

- Single Molecular Spectroscopy (including Raman and Fluorescence)
- Photoluminescence (PL) and refractive index mapping
- Tip Enhanced Raman Spectroscopy with 30nm lateral resolution
- Scanning Confocal Microscopy with AFM for characterizing Vertical Cavity Surface Emitting Lasers (VCSEL), Focal Plane Array (FPA) detectors and Non-linear Optical (NLO) crystals.



Confocal images of FPA with 6.7 µm deep trenches

Through *optical sectioning* a side wall profile can be obtained. Images are focused at different depths from the pixel top (left). The dashed lines (different colors) inside the figures correspond to the cross sections used to create the FPA side wall profile (right). The data suggests the resolution to be better than 50nm lateral and 150 nm in height.