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NEWS FROM THE RSC

MAIC-PAIC NFMC NRF

MAIC – Major Analytical Instrumentation Center

NFMC - Nuclear and Fuels Materials Characterization Facility

NRF – Nanoscale Research Facility

PAIC – Particle Analysis Instrumentation Center

How to become a user?

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MAIC-PAIC

NEWS & ANNOUNCEMENTS

Users Meeting: Every Tuesday
12:00 – 1:30 p.m. - 115 NRF

Only 7 days until Nano Day!
Nano Day 2019 Agenda
(photos from Nano-Day 2018)
Wednesday, October 9, 2019

INSTRUMENTATION HIGHLIGHTS

New Transmission Electron Microscopes and Plasma FIB (MAIC)
Autosorb (PAIC)

RSC NOTABLE USER

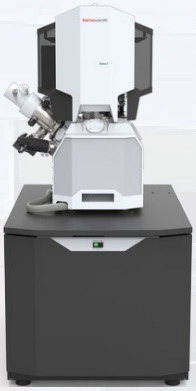
Zachary Randall
Biologist in the division of fishes and scanning technician for oVert.
Florida Museum of Natural History

Themis™ Z S/TEM for Materials Science

The ultimate in optical performance, reproducibility and flexibility. In order for scientists to advance their understanding of complex materials and develop innovative new materials, they must be able to correlate form and function, resolve in space, time and frequency and investigate with robust, precise instrumentation. Thermo Fisher Scientific introduces Themis Z – the next generation, ultra-high resolution, aberration corrected, scanning transmission electron microscope delivering the ultimate optical performance and flexibility with unprecedented reproducibility.

- www.thermofisher.com/order/catalog/product/THEMISZ?SID=srch-srp-THEMISZ

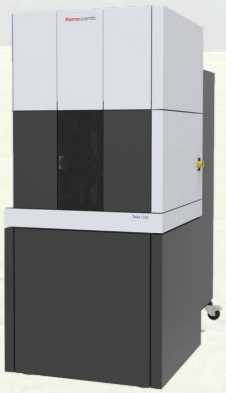
Scios™ 2 DualBeam™



"The Thermo Scientific™ Scios™ 2 DualBeam™ is an ultra-high-resolution analytical FIB-SEM system that provides outstanding sample preparation and 3D characterization performance for the widest range of samples, including magnetic and non-conductive materials. With innovative features designed to increase throughput, precision, and ease of use, the Scios 2 DualBeam is an ideal solution to meet the needs of scientists and engineers in advanced research and analysis across academic, government, and industrial research environments".

- www.thermofisher.com/order/catalog/product/SCIOS2?SID=srch-hj-SCIOS2

Talos™ F200i S/TEM



"The Thermo Scientific™ Talos™ F200i S/TEM is a 20-200 kV field emission (scanning) transmission electron microscope uniquely designed for performance and productivity across a wide range of Materials Science samples and applications. Its standard X-Twin pole piece gap—giving the highest flexibility in applications—combined with a reproducibly performing electron column opens opportunities for high-resolution 2D and 3D characterization, in situ dynamic observations, and diffraction applications."

- www.thermofisher.com/order/catalog/product/TALOSF200I

AUTOSORB IQ

Fully automated high-resolution gas sorption analyzer possessing three sample ports (analysis station) and four sample preparation ports (outgassing station). Includes a turbo-molecular drag pump and low-pressure transducers (10 and 1 Torr) for measurement of adsorption behavior at pressures required for low surface area measurements (requires krypton) and to observe the filling of micro-pores.

One port is available as a chemisorption station, complete with a high-temperature (1100ºC) furnace coupled with fan-assisted cooling, and a digital temperature controller for precise chemisorption measurements. Includes automated gas switching, in-situ and/or separated sample preparation.

A vapor dosing option is available for both physi - and chemi- sorption analysis and features a 50ºC thermostatted manifold chamber. Typical vapors include water, alcohols, and aromatics which can impact material characteristics, shelf life, performance, and stability.

- BET surface area range from ~0.0005 m2/g to no known upper limit.
- Pore size distribution range (0.35 nm-500 nm).

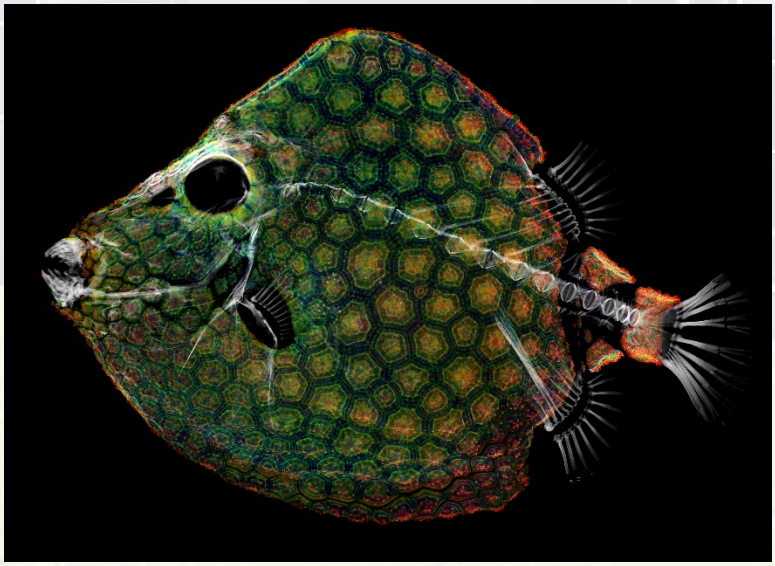
Also, our Autosorb iQ is integrated with a thermal conductivity detector (TCD) & cold trap option and includes electronic loop injection. TCD enables to perform temperature programmed methods TPR (temperature-programed reaction)/ TPD (temperature-programed desorption)/ TPO (temperature-programed oxidation) and pulse chemisorption analyses for use with a wide-range of gases. The included, automatic loop injector allows for easy pulse titration analyses as well as peak calibration activities.

RSC – MAIC-PAIC Notable User
Zachary Randall

Biologist in the division of fishes and scanning technician for oVert.
Florida Museum of Natural History

Zach Randall is a Biological Scientist at the Florida Museum of Natural History who specializes in imaging natural history collections to be made digitally accessible to researchers and the public. He has produced over 2,200 microCT scans of 1,100 vertebrate species at NRF for the openVertabrate (oVert) project and has co-developed high-throughput workflows for scanning and data management. The project's goal is to CT scan more than 80% of vertebrate genera and make the data publicly available to allow for a deeper exploration of morphological diversity.

This image is a CT scan reconstruction of the Whitebarred boxfish, *Anoplocapros lenticularis* (YPM ICH 006259) from the Yale Peabody Museum and scanned at NRF. The species is endemic to temperate waters of southern and western Australia. Like other temperate boxfishes, its body is enclosed in a bony carapace derived from modified scales, which vary in density as shown by the colors in the image. The missing section of carapace around the caudal fin functionally allows for more mobility.



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NFMC

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INSTRUMENTATION HIGHLIGHTS

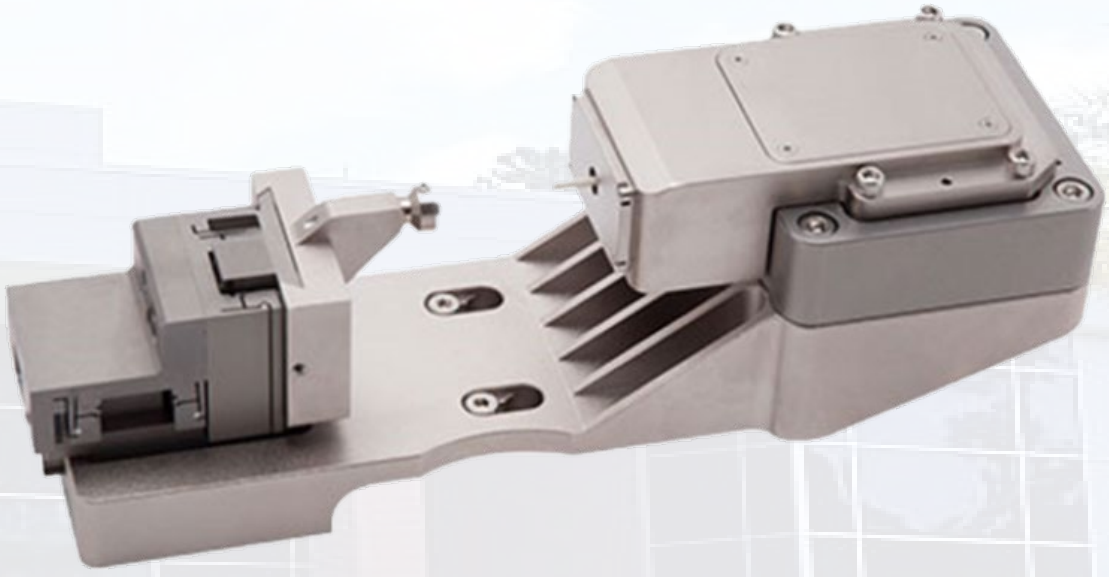
Pico-Indenter

RSC NOTABLE USER

Tanvi Ajantiwalay
Advisor: Dr. Assel Aitkaliyeva
Manatee Research Group
Nuclear Engineering Sciences

PI 88 Picoindenter

The Helios600 dual beam FIB/SEM at the NFMC facility has an available PI 88 Picoindenter for small scale mechanical testing. This attachment is an *in-situ* mechanical testing device that operates within the FIB/SEM. Live deformation videos during mechanical testing can be captured with the SEM electron beam. This allows a correlation of microstructure with mechanical properties of materials. The PI88 Picoindenter is equipped with a standard transducer having a force limit of 30 mN and a high load transducer having a force limit of 500 mN.



Instrument Configuration :

Flat punch (20 µm), Berkovich and Cube Corner indenter probes available
Max Force 30 mN (standard transducer), 500 mN (high load transducer)
Force Noise Floor <0.4 µN
Max Displacement 5 µm (standard transducer), 150 µm (high load transducer)
Displacement Noise Floor <1 nm
Feedback Control Rate 78 kHz
Max Data Acquisition Rate 39 kHz Sample
Positioning Range XYZ >3 mm
DMA analysis: 1 Hz – 300 Hz

RSC – NFMC Notable User
Tanvi Ajantiwalay

Manatee Research Group * Advisor: Dr. Assel Aitkaliyeva
Nuclear Engineering Sciences

My research focuses on the small-scale mechanical characterization of 304, 316 and HT-9 structural steels used in Generation IV nuclear reactors. My primary focus is on micro-tensile testing with specimens having a few micrometers overall dimensions. Such small-scaled specimens are fabricated using the FEI Helios dual beam FIB/SEM located at the NFMC facility. A series of combinations of voltages and currents are used to mill these T-shaped specimens from the bulk steel sample. The micro-tensile testing on these specimens is then performed using a Hysitron PI88 PicoIndenter assembly that is an attachment to the FIB/SEM stage.

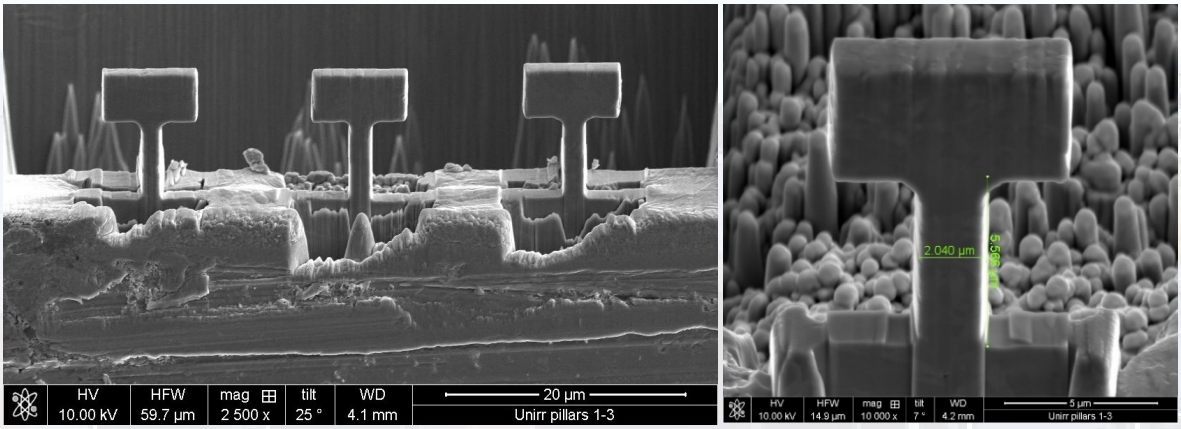


Fig 1: Micro-tensile specimens fabricated from HT-9 steels.

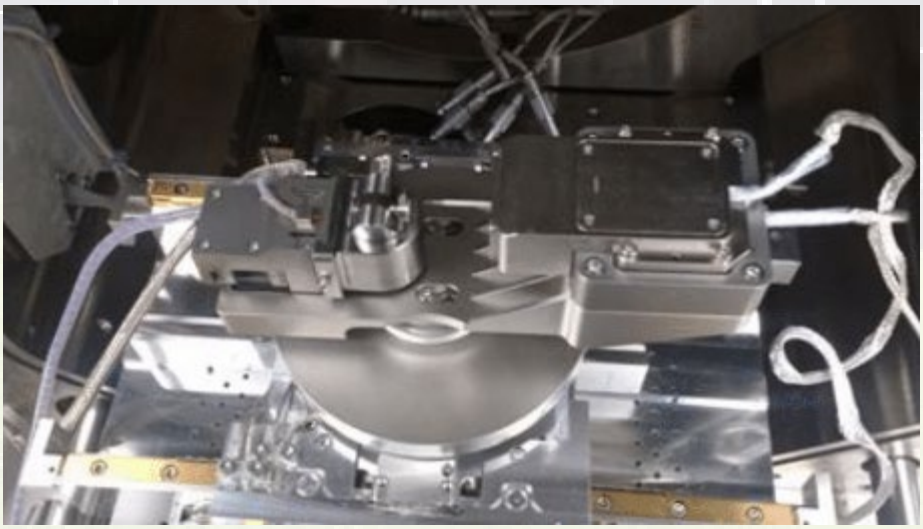


Fig 2: PI88 PicoIndenter inside the FIB/SEM chamber

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NRF

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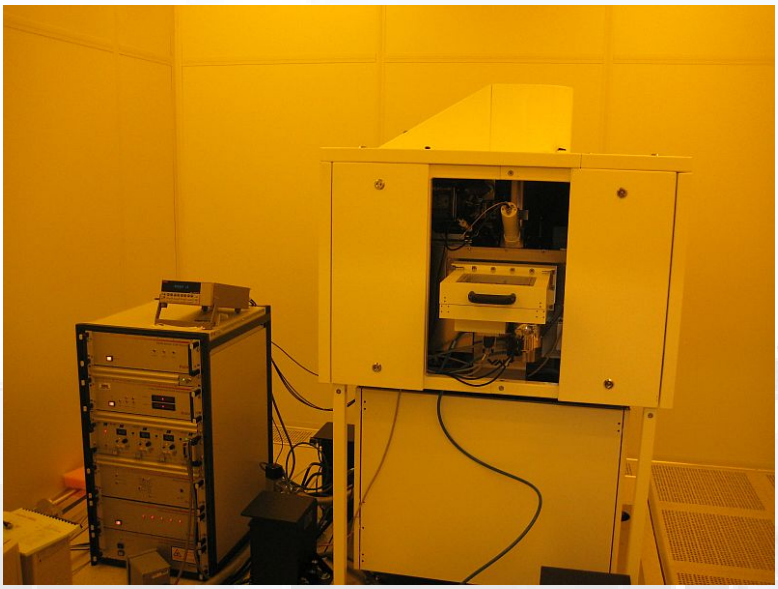
INSTRUMENTATION HIGHLIGHTS

E-Beam Lithography

RSC NOTABLE USER

Glen Walters
Advisor: Dr. Toshi Nishida
Electrical and Computer Engineering

The **RAITH150** is a multipurpose tool capable of direct e-beam exposure, wafer scale process development at suboptical resolution. The system includes integrated linewidth and metrology functions which give the user the ability to optimize process reproducibility.



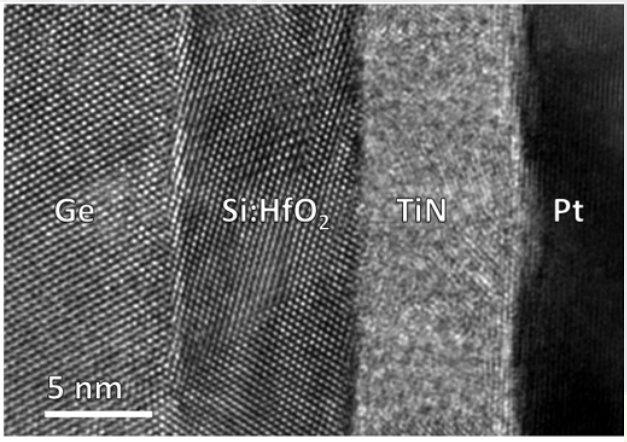
Features:

-Field Emission tip with acceleration voltage 200 eV - 30 KeV
-Probe current range 4 pA - 10 nA
-Writing field size variable 1 µm - 800 µm
-Working distance Variable 2 - 12 mm
-Automated load lock,height sensing
-Laser interferometer 2 nm resolution
-Sample holders available Wafer: 4
-Universal sample for small pieces and wafers
-Module with motorized rotation and tilt function for inspection.

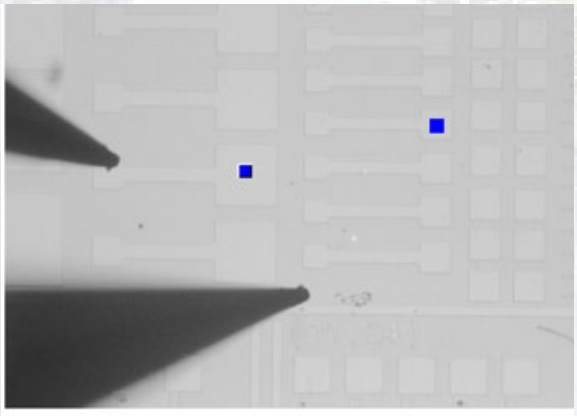
RSC – NRF Notable User
Glen Walters

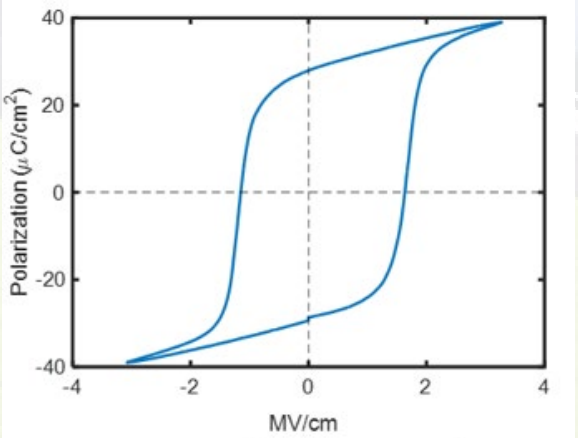
Advisor: Dr. Toshi Nishida
Electrical and Computer Engineering

My research focuses on the fabrication and characterization of ultra-thin film ferroelectric hafnium oxide devices. Aside from the pre-purchased silicon substrates, the devices are fabricated entirely in house at the NRF. Atomic layer deposition is utilized to precisely layer hafnium oxide with a variety of other materials such as zirconium oxide, silicon oxide, or aluminum oxide, which tune the resulting ferroelectric properties. ALD TiN electrodes can be deposited on the top and bottom of the hafnium oxide layer to make metal-ferroelectric-metal devices (MFM), or just on the top with silicon or germanium on the bottom for metal-ferroelectric-semiconductor devices. After blanket electrode deposition, lift-off photolithography is used to pattern sputtered platinum electrodes. These platinum electrodes are then used as a hard mask to etch the exposed TiN to separate and create various device geometries.



TEM image of MFS device


Capacitor Pads and Probes



Ferroelectric Hysteresis

Nano-Day 2018