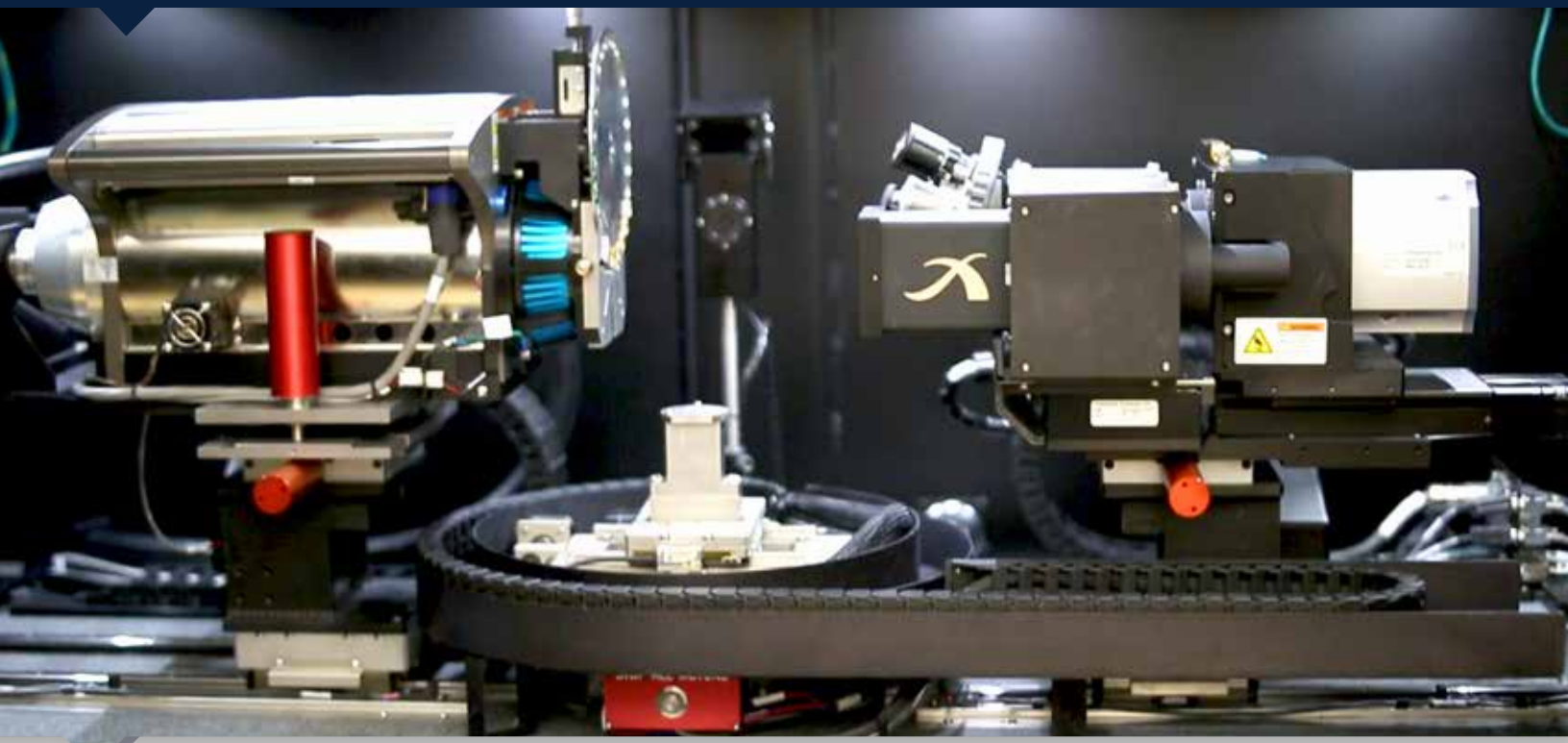
REVERSE ENGINEERING, FABRICATION, INSPECTION, AND NON-DESTRUCTIVE EVALUATION (REFINE) LAB

INNOVATION PARTNERSHIP BUILDING AT UCONN TECH PARK



About

REFINE Lab is a partnership between UConn and ZEISS which houses state-of-the-art light, X-ray, electron and ion microscopes. The lab focuses on "Correlative Microscopy" where information from multiple imaging modalities can be integrated in order to reach a much deeper understanding of imaged samples. REFINE Lab's instruments can "talk" to each other enabling researchers to gain a multi-dimensional, multi-resolution and multi-scale perspective about the studied sample. REFINE is also a pioneer in non-destructive imaging methods in 3D and 4D (in situ through time) where the same area of the sample can be imaged while applying mechanical loads, thermal loads, etc. in 3D.

UConn researchers in various engineering and science departments are relying on REFINE for their advanced characterization. REFINE is also working closely with industries in areas of Electronics and Hardware Security, Biomedical Devices, Batteries and Energy Storage, Aerospace, Advanced Coatings and Additive Manufacturing.

Areas of Expertise

Applications

- Hardware Security
- Circuit Edit and IC Debugging
- Semiconductor and Lithography
- Batteries and Energy Storage
- Failure Analysis and Forensic Analysis
- Advanced Coatings
- Biomedical Devices

Methods

- 3D X-ray Tomography
- 3D FIB Tomography
- 3D EDS
- 3D SEM Imaging
- Non-destructive Methods
- Correlative Microscopy
- In Situ Imaging
- Computational Microscopy
- Light and Confocal Microscopy

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Center Characteristics

Overview

The questions raised in modern research demand a multi-scale investigation, which in turn requires a multi-dimensional, multi-instrument, multi-modal characterization. REFINE Lab and ZEISS are addressing these challenges with software and hardware that combine multiple data sources within a single experiment. UConn REFINE has instruments that cover a broad range of length scales and modalities including: optical, 3D X-ray, electron, and ion microscopy. Correlative Microscopy is the main theme of this center where information is not only preserved and transferred from one instrument to another but also will inform the next instrument where and how the next step will be performed. The whole process is now automated under collaborative efforts between ZEISS and UConn.
Using image processing and machine learning, we take the understanding one step further through quantification of important parameters such as porosity in 3D, evolution of cracks and microstructure in 4D (in situ through time) among many others.

Technology

REFINE houses state-of-the-art instruments in a variety of characterization methods, ZEISS Smartproof and Smartzoom cover the light and confocal microscopy where overall inspection and surface characterization (e.g. Roughness measurement) are the primary applications. Light and confocal microscopy are extensively used in life sciences. ZEISS Crossbeam is the only FIB-SEM system equipped with LASER that can combine multi-scale milling from millimeters to nanometers with high resolution imaging using ZEISS GEMINI technology. ZEISS Orion Nanofab is the world's only helium and neon microscope where angstrom-scale resolution can be achieved in a scanning microscope. They also can be used to add, subtract, or otherwise modify specimens at the nanometer scale, allowing researchers to nanofabricate devices for a variety of applications. ZEISS X-ray microscopes (Versa 520 and 400) use unique X-ray focusing and detector designs to obtain high resolution, high contrast 3D tomographic data down to nanometer-scale resolution. Furthermore, the non-destructive nature of the method has enabled an increased variety of in situ and 4D imaging workflows.

Future Direction: Beyond Microscopy

REFINE is committed to taking microscopy beyond characterization and fancy images. Advanced Image Visualization and Image Processing are inseparable parts of modern microscopy. REFINE is actively pursuing efforts in this field through developing in-house algorithms inspired by machine learning and neural networks. We have developed algorithms to make detection automated. We can also successfully convert images to 3D models using our reverse engineering capabilities and further study samples thanks to integration with Finite Element Analysis. Compressed Sensing and Image Restoration Algorithms are a few of other future directions of REFINE that target computational microscopy. Applications of lasers in microscopy are also one of our target areas of research.

Key Components of ZEISS Partnership

- Research funding on Correlative Microscopy
- Advanced training
- Premium service maintaining high uptime

Contact

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