Meeting Announcement from MMMS 2025

Hosted by Baxter Healthcare Corporation

Presented by

Midwest Microscopy and Microanalysis Society (M^3S)

A local affiliate of the Microscopy Society of America and the Microanalysis Society

Friday, November 21st

Baxter Healthcare Headquarters

1 Baxter Parkway, Deerfield IL, 60015

Directions see page 3

Register by Friday, November 14th

Use the link below, this is required to reserve a lunch for this event

https://web.cvent.com/event/4bb3c17b-64eb-4d36-9adb-b6ed3d3ebe18/summary?RefId=M3SFall2025

Registration Fees

Meeting Free for M^3S members and all students, $20.00 for non-members
(Fee includes M^3S membership for 2025)
Vendors are welcome to exhibit, fee is $125.00.

Program

8:00 – 9:00AM **Registration -** Continental Breakfast

9:00 – 9:05AM **Welcome and Opening Remarks**

Downloadable abstracts here:
http://midwestmicroscopy.org/PDF/MMMS_Nov_2025_Meeting_Abstracts.pdf

9:05 – 9:40AM Exploring Beam-Induced Damage in MOFs from Cryogenic to Room Temperature Conditions

Dr. Gabriel Trindade dos Santos, Northwestern University

Metal-Organic Frameworks (MOFs) are promising candidates for applications in the pharmaceutical industry, ranging from drug delivery to Diagnosis and Bioimaging. Much has been learned about these materials using Transmission Electron Microscopy (TEM). However, their extreme sensitivity to electron beam limits both data quality and the range of techniques applicable for their characterization. The use of Cryo Electron Microscopy (CryoEM) has opened a new temporal window to study these materials under more stable conditions. Nevertheless, it remains crucial to understand MOFs in the temperature range relevant to real applications: from room temperature up to a few degrees.

Here, we use a cryo holder to investigate beam-damage processes in the MOF MIL-101(Fe) at two temperature regimes: cryogenic and room temperature. I will present my recent results showing how beam-induced damage evolves under these conditions and how I am developing approaches to monitor and quantify this process. In addition to the MOF studies, I will also present some other projects performed at cryogenic temperatures.

9:40 – 10:25AM CryoEM in Pharma: Bridging Structural Biology and Therapeutics

Prof. Wei Liu, Medical College of Wisconsin - **Keynote Speaker**

Advances in cryo-electron microscopy (CryoEM) and complementary structural methods are revolutionizing drug discovery. In this talk, I will highlight our recent studies of dopaminergic signaling, where CryoEM, MicroED, and lipidic cubic phase (LCP) technology uncover conformational states critical for downstream pathways. These structural insights open opportunities to identify new druggable mechanisms.

I will also discuss the application of these tools to the development of proteolysis-targeting chimeras (PROTACs). High-resolution structures of E3 ligases in complex with receptor targets provide a framework for designing degraders against cancer targets that have been difficult to treat with conventional strategies.

Together, these approaches demonstrate how next-generation structural biology can connect fundamental insights in cancer biology with translational therapeutic development, accelerating the path from molecular understanding to new treatment strategies.

10:25 – 10:45AM Break – Visit with Vendors

10:45 - 11:20AM Cryo-APT: Insights into the Atomic-Scale Structure and Composition of the Hydrated Mineral–Matrix Interface

Dr. Katsuaki Naito, Northwestern University

Understanding protein structures, including their chemical components, is essential for elucidating biological functions and designing medical drugs. Cryogenic Atom Probe Tomography (Cryo-APT), a chemical imaging tool with unrivaled spatial resolution (< 0.2 nm), offers the potential to address unresolved biological questions by analyzing specimens in their natural state. However, preparing biological samples for Cryo-APT is highly challenging, as it requires needle-shaped specimens with radii below 100 nm and GIS-free lift-out. Here, we introduce a Cryo-APT approach for biological tissues, specifically mineralized collagen fibrils and human dentin (composed of hydroxyapatite, collagen fibrils, proteoglycans, small proteins, and water). We discuss the technical challenges, possible solutions, and prospects of applying Cryo-APT to biological samples, expecting that establishing this Cryo-APT workflow will enable characterization of ion–protein–water interactions and contribute to the development of new treatments.

11:20 - 11:45AM Unlocking Molecular Secrets: The Power of Cryo-EM in Small Molecule Drug Discovery

Dr. Kazi Waheeda, Thermo Fisher Scientific

Cryo-electron microscopy (cryo-EM) is redefining the landscape of small molecule drug discovery by enabling rapid, high-resolution visualization of drug targets in their native states. The technique allows researchers to directly observe how small molecules interact with complex and dynamic proteins—particularly membrane proteins and other challenging targets that are often inaccessible by traditional X-ray crystallography. With advances in single-particle analysis (SPA), automated data acquisition through Thermo Scientific™ Smart EPU™, and integrated real-time processing using CryoSPARC Live™, structural information can now be obtained within hours rather than weeks. This accelerated workflow supports early-stage hit validation, structure-guided optimization, and assessment of binding modes and conformational effects, reducing both time and cost in the discovery process. In-house cryo-EM capabilities further enhance efficiency by minimizing sample transport, preserving sample quality, and providing immediate feedback to guide decision-making. By integrating seamlessly with existing screening and computational approaches, cryo-EM is emerging as an indispensable tool for accelerating structure-based drug design. Its ability to link molecular structure directly to therapeutic function is transforming how the pharmaceutical industry approaches innovation and development of new small-molecule therapeutics.

11:45AM - 12:10PM The impacts of silane functionalized hydrogels on early-age nucleation and growth of cement hydrates

Akul N. Seshadri, Purdue University

This talk showcases how CryoSEM can be utilized to characterize hydrated polymeric and ceramic systems. Hydrogel-based superabsorbent polymers (SAPs) have been explored for internal curing of concrete, but conventional hydrogels primarily release water without participating directly in cement hydrate growth. We synthesized silane-functionalized hydrogels designed to both supply water and promote calcium silicate hydrate (C-S-H) nucleation. Early-age interactions with cement paste were probed using cryogenic scanning electron microscopy (CryoSEM), enabling direct observation of hydrate formation between 3–21 hours of cement hydration. CryoSEM revealed that these hydrogels dissolve in alkaline environments, diffuse into cement paste, foster nucleation-dominated hydrate growth, and reduce void formation. This work demonstrates new hydrogel compositions with commercial potential as next-generation curing and seeding agents for cementitious systems.

12:10 – 1:45PM Lunch – Visit with Vendors

(Complementary to Registered Attendees)

Exhibiting at the Fall Meeting: Bruker, Deben, DMC, Gatan/Ametek, Heartland BioTech, Hitachi, JEOL, Microscopy Innovations, Oxford, Renishaw, Semplor, Tescan, ThermoFisher, Thomas Scientific/NCI, Zeiss

1:45 – 2:00PM M3S Business Meeting

2:00 – 2:45PM CryoEM studies of photoreceptor kinases: light signaling and allostery regulation

Prof. Xiaojing Yang, University of Illinois Chicago - **Keynote speaker**

Bilin-based photoreceptors in the phytochrome superfamily mediate a wide range of light responses in plants, fungi and bacteria. In bacteria and cyanobacteria, they are involved in gene regulation of proteins constituting the photosynthetic apparatus and enzymes enabling complementary chromatic acclimation. Many bilin-based photoreceptors are multi-domain sensor histidine kinases that confer light signaling via a two-component system where they serve as the first component to perform light-dependent auto-phosphorylation. Despite extensive studies, how light-regulated allosteric action is achieved at the molecular level is not fully established. We investigate the signaling logic and molecular mechanism of two representative photoreceptors using biochemistry, dynamic crystallography, single particle cryoEM and structural meta-analysis. By provoking, probing and resolving the light-induced structural changes in both isolated photosensory domains and full-length proteins, we aim to elucidate the long-range signaling mechanisms in modular photoreceptors and other dimeric receptor kinases that share a similar protein architecture. Findings promise to offer optogenetic solutions for biomedicine and renewable energy research. In this talk, I will present our recent results from cryoEM studies of two full-length modular photoreceptors from the purple bacterium and cyanobacteria. I will also discuss strategies with examples to demonstrate the utility of cryoEM single particle analysis in drug discovery.

2.45 - 3:05PM Large-Format Direct Detection Camera for 80-200 keV Cryo-EM Imaging

Dr. Stephen Mick, Gatan, Inc.

Single-particle cryo-electron microscopy (Cryo-EM) has emerged as a leading technique in structural biology for elucidating the structures of dynamic macromolecules. High-resolution cryo-EM typically requires high-voltage cryo-transmission electron microscopes (cryo-TEMs) equipped with coherent field emission gun (FEG) sources, stable columns, autoloader systems, and counting direct detection cameras, all of which are expensive. Recently, the use of 100-keV cryo-TEMs has been proposed to increase accessibility to cryo-EM and reduce its operational costs. Advancements in direct detection technology have led to the development of the Alpine camera, exhibiting an entirely new pixel design and significant improvements in detective quantum efficiency (DQE) at lower voltages (≤200 keV). The Alpine detector has achieved sub-2Å reconstructions of apoferritin and ~3.2Å for the LKB1 complex at 120 keV on a TFS Glacios microscope. Detailed analysis showed that Alpine reconstructions are comparable to K3 reconstructions at 200 keV. Remarkably, the Alpine LKB1 reconstructions at 120 keV outperformed the 200 keV data obtained using either the Alpine or K3 detectors. These findings suggest that lower-voltage TEMs, when paired with advanced detectors, could leverage the advantages of lower accelerating voltages and expand the scope of cryo-EM to include small proteins. Additionally, upgrading a standard 120-keV LaB6 TEM with the Alpine camera achieved 2.65Å resolution for apoferritin, 4.33Å for 64 kDa hemoglobin, and 4.4Å for the 153 kDa GPCR (M4 muscarinic acid receptor). Such a configuration offers a cost-effective solution for obtaining high-quality cryo-EM structures without needing FEG sources, further lowering the economic barrier for advanced cryo-EM studies.

3:05 – 3:15PM Closing Remarks

Directions to Baxter Corporate Headquarters: 1 Baxter Parkway, Deerfield Illinois, 60015

From South (O'Hare Airport): I-294 (Tri State Tollway) north to the merge with I-94 (west) towards Milwaukee. North on I-94 to Lake Cook Road exit. Turn left (west) to first light, Saunders Road. Turn right on Saunders to Baxter Parkway. Turn right on Baxter Parkway. Keep to the right. Follow the special event parking signs in the garage. See Deerfield Campus Map and proceed to "Cafeteria, Auditorium, Reception" building on ground level.
From South (Edens): North to the merge with I-94 (west) towards Milwaukee on Edens Spur. Exit on Deerfield Road. Turn left (west), then take left on Saunders Road. Turn left on Baxter Parkway. Keep to the right. Follow the special event parking signs in the garage. See Deerfield Campus Map and proceed to "Cafeteria, Auditorium, Reception" building on ground level.
From North (Milwaukee): From I-94 east, going south towards Chicago exit at Lake Cook Road exit. Turn right (west) to first light, Saunders Road. Turn right on Saunders to Baxter Parkway. Turn right on Baxter Parkway. Keep to the right. Follow the special event parking signs in the garage. See Deerfield Campus Map and proceed to "Cafeteria, Auditorium, Reception" building on ground level