Oklahoma Microscopy Society Spring Meeting 2026 Program

University of Oklahoma – National Weather Center

120 David L Boren Blvd, Norman, OK 73072

May 1st, 2026

Welcome to the Oklahoma Microscopy Society Spring Meeting 2026, hosted at the beautiful University of Oklahoma campus in Norman. We are thrilled to gather once again to celebrate the cutting-edge microscopy research across our state.

As we look forward to a day filled with insightful talks, engaging discussions, and presentations, we encourage you to take full advantage of the opportunities to network with fellow researchers, vendors, and educators.

We are grateful to our speakers, sponsors, volunteers, and attendees who make this meeting possible.

Thank you for joining us!

With warm regards,

The Oklahoma Microscopy Society Organizing Committee

2026 Oklahoma Microscopy Society Spring Meeting Schedule

Friday, May 1st, 2026

8:00 - 9:00 AM	Registration, Vendor and Poster Setup, Coffee & Light Breakfast	
9:00 - 9:05 AM	Opening Remarks **Dr. Tingting Gu** (OU, SRNML, OMS), **Dr. Ann West** (OU, OVPRP)	
9:05- 10:05 AM	Keynote Presentation - **Dr. Priyamvada Acharya** *Structural virology with a 100 keV cryo-TEM*	
10:05 - 10:30 AM	**JEOL USA Inc.** Sponsored Coffee Break & Vendor Showcase	
10:30 - 10:45 AM	Faculty Presentation – **Dr. Jian Zhao** *Computational chemical microscopy imaging*	
10:45 - 11:00 AM	Student Presentation – **Kole Long** *Determining the structure of CRISPR type II-A spacer acquisition*	
11:00 - 11:15 AM	Student Presentation – **Rose Johnson** *Quadruple imaging modalities of Chlamydomonas illuminate TOGARAM1's role governing ciliary microtubules*	
11:15 - 11:30 AM	• Attendees of the **Lunch & Learn Option 1 (TFS Tundra)** walk to the Stephenson Life Sciences Research Center (SLSRC) 101 Stephenson Pkwy, Norman, OK 73019 • Attendees of the **Lunch & Learn Option 2 (JEOL NeoARM)** stay at the National Weather Center (NWC)	
11:30 AM - 1:30 PM	**Lunch and Learn – Option 1** Thermo Fisher Scientific Tundra Cryo-TEM in SLSRC	**Lunch and Learn – Option 2** JEOL NeoARM and 4D STEM in NWC
1:30 - 1:45 PM	Attendees of Lunch & Learn Option 1 walk back to NWC	
1:45 - 2:00 PM	Vendor Talk – **Brian Templin, Tomocube, Inc.** *Holotomography: Label-free 3D Live Cell Imaging*	
2:00 - 2:15 PM	Vendor Talk – **John Grimes, JEOL USA Inc.** *New Cryo EM and Cryo Dual Beam Technology from JEOL.*	
2:15 - 2:30 PM	**Tomocube, Inc.** Sponsored Coffee Break & Vendor Showcase	
2:30 - 3:30 PM	Keynote Presentation - **Dr. Yongtao Liu** *Self-driving scanning probe microscopy via programmatic control and real-time machine learning*	
3:30 -3:35 PM	Coffee Break	
3:35 - 3:50 PM	Student Presentation – **Nagarajan Anna Ramesh Babu** *Thickness-dependent high-entropy-alloy nanoparticle formation via pulsed laser-induced dewetting*	
3:50 - 4:05 PM	Student Presentation – **Ramji Subedi**	

	Machine learning-enhanced atomic insights into strain accommodation and epitaxial stabilization of $Ba(ZrSnTiHfNb)O_3$ high-entropy oxide thin films
4:05 - 4:30 PM	Poster Session
4:30 - 5:00 PM	Awards and Closing

Keynote Presentation – Dr. Acharya

Structural virology with a 100 keV cryo-TEM

Dr. Priyamvada Acharya
Professor, Department of Surgery
Professor, Department of Biochemistry
Director, Division of Structural Biology
Director, Duke Center for HIV Structural Biology
Duke Human Vaccine Institute
Duke University School of Medicine

Abstract
Cryo-electron microscopy (cryo-EM) has transformed structural biology, particularly for flexible and heterogeneous samples, yet access to high-end microscopes remains a major bottleneck. Although 300 keV microscopes are the standard for high-resolution structure determination, their cost, operational complexity, and centralization in institutional or national facilities severely limit availability. Here, we demonstrate user-managed operation of a lower-cost 100 keV electron microscope housed within a structural biology laboratory, enabling tight integration with protein production and biochemical and biophysical analyses. We describe installation requirements, routine maintenance, and day-to-day operation, and use virus surface glycoproteins as case studies to illustrate workflows for grid screening, data collection, and data processing, along with representative data quality metrics. This setup serves as an effective training platform: with regular use and instruction, beginners can achieve independent operation of the microscope within one month. We routinely obtain high-quality, albeit low-resolution, reconstructions using a Ceta CMOS camera, as well as high-resolution reconstructions suitable for atomic model building using a Falcon C direct detector. This work demonstrates how a research group can successfully combine independent microscope operation with a full cryo-EM workflow.

Biography
Dr. Priyamvada Acharya is a Professor in the Department of Surgery at Duke University Medical Center and the Director of the Division of Structural Biology at the Duke Human Vaccine Institute (DHVI). Dr. Acharya is the Director of the NIH-funded Duke Center for HIV Structural Biology (DCHSB).

Keynote Presentation – Dr. Liu

Self-Driving Scanning Probe Microscopy via Programmatic Control and Real-Time Machine Learning

Dr. Yongtao Liu
Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA

Abstract
Microscopy is a primary tool for establishing structure–property relationships at the micro- and nanoscale across diverse fields, including electronic materials, energy storage, catalysis, quantum materials, structural alloys, and biomaterials. Although the information content of modern microscopes has grown exponentially, the pace of human-driven experimentation has not. Self-driving microscopy addresses this gap by transforming microscopy from a manually operated instrument into a programmable, decision-making experimental platform. Instead of collecting data point-by-point according to a fixed plan, self-driving microscopy determines what to measure and how to measure it through real-time analysis. This shift conceptually changes the role of microscopy from passive characterization to autonomous experimental planning and control.

In this talk, I will present our work on developing a programmatic control platform for microscopy and integrating artificial intelligence (AI)/machine learning (ML) into real-time experimental science to enable autonomous materials discovery and optimization. By embedding AI algorithms directly into the instrument control loop, we implement closed-loop experimentation in which the system analyzes incoming data, updates ML model, and iteratively adjusts experimental plans based on evolving insights. In addition, I will also discuss incorporating quality-control mechanisms in autonomous microscopy to prevent the propagation of measurement errors and maintain scientific validity. Together, these advances outline an AI-driven autonomous microscopy that has the potential to accelerate scientific understanding and enable materials discovery at a scale and speed not achievable with conventional experimentation.

Biography
Dr. Liu is a staff scientist at the Center for Nanophase Materials Sciences (CNMS) at Oak Ridge National Laboratory (ORNL). Dr. Liu's current work focuses on integrating artificial intelligence (AI) with physics to develop autonomous experimentation platforms, especially autonomous microscopy, that accelerate progress in materials science. He is engaged in interdisciplinary projects and is committed to fostering synergy between human expertise and AI, he strives to develop innovative tools and methods that empower researchers worldwide. Dr. Liu's research interests also include functional materials, including ferroelectric, optoelectronic, and photovoltaic materials. His contributions to the field have been recognized with multiple awards / honors, such as the Microscopy Society of America Postdoctoral Scholar Award, the Joseph E. Spruiell Award for Excellence in Research, ORNL Outstanding Scholarly Output Award, Microscopy Today Innovation Award, R&D 100 Award, and Rising Star in Nanoscience.

Abstracts - Student and Faculty Presentations

Computational Chemical Microscopy Imaging

Jian Zhao
Assistant Professor, Stephenson School of Biomedical Engineering, The University of Oklahoma, Norman, OK, USA

Abstract
Volumetric in situ imaging of the morphology and chemical composition of subcellular structures within intact cells lays the foundation for studying cellular functions and related disease mechanisms. Despite its significance, it remains a grand challenge to image and analyze both macromolecules and small molecules with minimal perturbation to cells and low invasiveness. The emerging optical mid-infrared photothermal (O-MIR) imaging technique demonstrates label-free, molecularly specific single-cell imaging with subcellular spatial resolution and high sensitivity, offering a promising route to address this challenge. In parallel, the development of computational microscopy opens avenues to video-rate quantitative 3D single-cell imaging. By integrating O-MIR with computational microscopy, we present the first non-interferometric computational mid-infrared photothermal microscopy platform, which enables 3D label-free or fluorescence-guided chemical imaging and site-specific infrared spectroscopy of biological specimens with subcellular spatial resolution and video-rate imaging speeds. Our method integrates pump–probe optical mid-infrared photothermal imaging into an intensity diffraction tomography platform, termed Bond-Selective Intensity Diffraction Tomography (BS-IDT). BS-IDT is implemented on a scan-free, modular bright-field microscope with add-on pulsed light sources. With this simple yet effective design, BS-IDT achieves subcellular-resolution (~350 nm lateral, ~1.1 μm axial) 3D infrared hyperspectral imaging over a ~100 μm × 100 μm field of view with volumetric imaging speeds ranging from ~0.05 Hz to ~6 Hz. BS-IDT enables site-specific mid-IR fingerprint spectroscopy with fidelity comparable to Fourier transform infrared spectroscopy. Building on this spectroscopic capability, BS-IDT demonstrates 3D label-free, molecularly specific single-cell imaging of bladder cancer cells, assesses features related to cancer invasiveness, and shows similar performance in the multicellular model organism *Caenorhabditis elegans*. Beyond label-free imaging, we further develop a fluorescence-guided BS-IDT method, termed FBS-IDT, which enables depth-resolved IR spectroscopic analysis of proteins and achieves volumetric visualization of the β-sheet secondary structure of intracellular tau aggregates within intact single cells, demonstrating its potential for studying neurodegeneration.

Determining the structure of CRISPR type II-A spacer acquisition

Kole Long[1], Swarmistha Aribam[1], Rakhi Rajan[1]
[1]*Department of Chemistry and Biochemistry, The University of Oklahoma,*

CRISPR-Cas systems provide adaptive immunity in prokaryotes by capturing and integrating fragments of foreign DNA, known as spacers, into the host genome. This process, called spacer integration, is catalyzed by the Cas1-Cas2 complex during the adaptation phase. This study focuses on the structural characterization of Cas1-Cas2 complexes from Type II-A CRISPR systems using cryo-electron microscopy (cryo-EM). Preliminary 3D reconstructions of the Cas1-Cas2-DNA complex have been obtained; however, the quality and resolution of these reconstructions are currently limited by particle heterogeneity. Variability analysis and 3D classification reveal distinct conformational states, suggesting the presence of mobile domains within the complex. Addressing this heterogeneity is crucial for achieving high-resolution structural models. A multifaceted strategy is being employed to improve complex homogeneity, including the use of freshly purified protein, immediate grid preparation following size exclusion chromatography, testing of cross-linking conditions, and optimization of grid-coating techniques. In parallel, advanced data processing techniques such as improved 3D classification and refinement strategies are being explored to better resolve structural variability. These efforts aim to capture stable conformations of the Cas1-Cas2-DNA complex, enabling detailed mechanistic insights into spacer integration. Ultimately, this work will enhance our understanding of the molecular basis of CRISPR adaptation and inform future applications in genome engineering.

Quadruple imaging modalities of *Chlamydomonas* illuminate TOGARAM1's role governing ciliary microtubules

Rose Johnson[1], Julie Craft Van De Weghe[1]
(1) Department of Cell Biology, University of Oklahoma Health Campus, OK City, OK

Cilia first graced the microscope of Antonie van Leeuwenhoek in 1675, and the field has soared with improving imaging technology. These micron-scale organelles have conserved functions and structure across eukaryotic organisms. Motile cilia mainly generate fluid flow, and primary (immotile) cilia act as signaling hubs. Both types contain nine pairs of highly specialized, remarkably stable microtubule doublets. In humans, cilia are required for life, and dysfunctional cilia can cause ciliopathies. Joubert syndrome (JS) is a neurodevelopmental ciliopathy diagnosed by the "molar tooth sign" on brain MRI. Individuals with JS have intellectual disability, developmental delay, ataxia, and hypotonia with variable other organ involvement. Over 40 genes are linked to JS, including *TOGARAM1*. TOGARAM1 contains four microtubule-binding TOG domains, and our studies in human cells alongside current literature suggest that this protein regulates microtubule growth and stability. I hypothesize that TOGARAM1 governs the ciliary doublets and disease defects destabilize their structure and disrupt ciliary homeostasis, ultimately impacting organelle function. In parallel with our human cell-based investigation of TOGARAM1's role in primary cilia, we use *Chlamydomonas reinhardtii,* a historic cilia biology model, due to its unique amenability for fixed- and live-cell imaging. The motile cilia of *Chlamydomonas* are near-identical to human motile cilia, and half of the JS genes are conserved in this biciliate alga, including the TOGARAM1 homolog, short flagella 1 (SHF1). I leveraged four imaging modalities to assess TOGARAM1's effects on ciliary microtubules.

First, I used transmission electron microscopy (TEM) to evaluate the ciliary microtubule ultrastructure, as I hypothesized that TOGARAM1 uses its four TOG domains to stabilize the doublet structure. I found that the microtubule doublets were intact in both mutants and controls. I next sought to determine if TOGARAM1 regulates ciliary microtubules via post-translational modifications (PTMs). PTMs can affect interactions between the microtubules and associated proteins, indirectly and directly influencing doublet structure and stability. I used quantitative immunofluorescence of spinning disk confocal micrographs to measure a panel of stability-associated microtubule PTMs and found similar PTM levels in mutants versus controls. I then evaluated ciliary microtubule stability using live cell differential interference contrast (DIC) microscopy to measure ciliary resorption and regeneration. I found that mutant cilia resorbed faster and regenerated more slowly than wild-type cilia, suggesting that SHF1 is important for microtubule stability during these transitions. Data collection was incomplete as the cell bodies obscured shorter cilia; I will bypass this limitation by using total internal reflection fluorescence (TIRF) microscopy. This imaging modality is especially well-suited for *Chlamydomonas* as the TIRF field only excites fluorescent molecules within 250nm of the coverslip, which corresponds to the diameter of *Chlamydomonas* cilia. In this high signal-to-noise system, we can image single particles moving in living cells while avoiding autofluorescence from chlorophyll in the cell body. I am now generating strains with fluorescently tagged tubulin for high-resolution imaging of the full resorption and ciliogenesis processes. Also leveraging TIRF microscopy, I assessed intraflagellar transport (IFT) speeds. IFT is a dedicated transport system that shuttles cargo between the base and tip of cilia by moving along the microtubules. I used kymographs from short TIRF live cell videos of strains with fluorescently-tagged IFT particles to calculate speed. In mutants, both directions of IFT movement were significantly slower. This is a novel finding, as there is little documentation of IFT slowing in *Chlamydomonas* ciliary mutants. These diverse imaging modalities facilitated a robust investigation of TOGARAM1's role in ciliary homeostasis and structure.

Lunch and Learn Presentations – Thermo Fisher Scientific

Note: This presentation is offered at the Stephenson Life Sciences Research Center (SLSRC)

Address
Stephenson Life Sciences Research Center (SLSRC)
101 Stephenson Pkwy, Norman, OK 73019

Discover Cryo-EM at the University of Oklahoma

Natalie Young, PhD
Sr Product Specialist for Life Science Electron Microscopy, Thermo Fisher Scientific

Abstract
Ever wonder what's happening with your protein of interest in your test tube? Cryo-electron microscopy (cryo-EM) directly images and analyzes protein structures in 3D. Discover the Thermo Fisher Scientific Tundra Cryo-TEM at U Oklahoma, making high-quality cryo-EM accessible to all researchers. Designed for usability and efficiency, the Tundra empowers scientists to unravel intricate molecular structures without the steep learning curve traditionally associated with cryo-EM. Join us for a seminar to learn how this powerful tool can enhance your research, hear the latest advances in the field, and get started with cryo-EM on campus!

University of Oklahoma Tundra Cryo-TEM Present and Future

Dr. Leonard M. Thomas
Biomolecular Structure Core Director, Department of Chemistry and Biochemistry, Oklahoma COBRE in Structure Biology, University of Oklahoma, Norman

A presentation and discussion session on the future of Cryo-TEM capabilities and research at the university of Oklahoma, Norman campus.

Lunch and Learn Presentations – JEOL

Note: These presentations are offered at the National Weather Center (NWC)

TEM Title: The Modern TEM: JEOL's Solutions for Control and Imaging

Tim Eldred, Ph.D
JEOL

Abstract
A discussion on the capabilities of the JEOL ARM Series. This Session will cover both current and emerging techniques and technologies for both image acquisition, microscope operation/automation and experimental control. Whether pursuing structural, chemical, or dynamic characterization at the atomic scale, e`ective transmission electron microscopy relies on maintaining user control across all aspects of the experiment. The NEOARM, equipped with PyJEM automation and 4D-STEM functionality, enables streamlined and customizable workflows, while complementary approaches including IDES EDM and SAAF imaging highlight the extended capabilities available across JEOL platforms.

Topics in FIB/SEM Technology and Workflows

Tim Eldred, Ph.D
JEOL

Abstract
A discussion on JEOL’s FIB/SEM solutions. This session will cover both technology and workflow optimizations to help push research and lab management forward. Be it for chemical, structural, or electronic characterization of defects and interfaces, it is oftentimes necessary to identify a TEM sample region of interest on the nanometer scale. The dual-beam focused ion beam/scanning electron microscope (FIB/SEM) remains the typical instrument for this type of TEM sample preparation. The JIB-PS500i aims to streamline lamella preparation workflow while simultaneously improving the quality of the lamellae.

Abstract - Vendor Presentation - Tomocube

Holotomography: Label-free 3D Live Cell Imaging

Brian Templin
Regional Sales Manager
Tomocube, Inc.
www.tomocube.com

Abstract
Holotomography is an emerging technology in the world of microscopy. This imaging technique yields high-resolution 3-D images of live or fixed samples without the need for fluorescent labeling. It is useful for a wide range of applications, including cultured cells, tissue sections, organoids, embryos, C. elegans, and many more. As a non-invasive and non-destructive imaging modality, it is extremely well suited for long duration timelapse acquisition experiments. And the resulting data can be used for a variety of analysis workflows, such as cell volume, lipid quantification (dry mass and concentration), mitochondria fission & fusion, organoid growth & morphology assessment, and more. Holotomography adds previously unseen information and data to your experimental workflow.

Biography
Brian has a bachelor's degree in aerospace engineering. He has been in the microscopy industry for 23 years. That includes 18 years with Nikon, 3 years with Echo, and the last 2 years with Tomocube. Brian resides in Houston, TX, and has the entire central United States for his territory.

Vendor Presentation – JEOL USA Inc.

New Cryo EM and Cryo Dual Beam Technology from JEOL.

John Grimes
CryoEM Sales Director, Americas
JEOL USA, Inc.
www.jeolusa.com

Abstract
JEOL will be announcing new Cryo TEM and Cryo Dual Beam models this summer. These new models are designed for laboratories with a broad set of applications and include the complete workflow needed for Cryo Tomography. We will discuss the newest CryoTEMs as well as the upcoming release of a Cryo Dual Beam.

Abstracts - Student and Faculty Presentations

Thickness-Dependent High-Entropy-Alloy Nanoparticle Formation via Pulsed Laser-Induced Dewetting

Nagarajan Anna Ramesh Babu[1], Vikas Reddy Paduri[1], Ramji Subedi[1], Manuel Roldan Gutierrez[2], Nozomi Shirato[3], and Ritesh Sachan[1]*
[1]School of Mechanical and Aerospace Engineering, Oklahoma State University, Stillwater, OK 74078, USA
[2]Eyring Materials Center, Arizona State University, Tempe, Arizona 85287, USA
[3]Center for Nanoscale Materials, Argonne National Laboratory, Lemont, Illinois, USA

Abstract
High-entropy alloy nanoparticles (HEA NPs), consisting of multiple constituent elements, have attracted significant attention due to their compositional complexity and structural stability that can cause potentially improved and durable functional properties. Recently, the concept of nanosecond laser induced dewetting of thin films has been demonstrated as a suitable tool to synthesize HEA NPs that ensure compositional homogeneity, morphological control, however, needs advancing its mechanistic understanding towards harnessing its potential. Here, we present a systematic study to investigate the formation of compositionally homogeneous NiCoCrFeCu HEA nanoparticles using nanosecond laser induced dewetting of alloy films. Dewetting of metallic thin films enables nanoparticle formation via melt-state breakup of thin films followed by material accumulation in nanoscale droplet shapes through surface gradients and capillary instabilities. The studies on thickness-dependent dewetting behavior of films (3-30 nm) reveal its dominant role over determining the characteristic length scales of nanoparticles, namely nanoparticle diameter and interparticle spacing while laser parameters such as fluence and irradiated count primarily govern the kinetics of pattern evolution. Unlike well-studied monometallic systems, where the dewetting length scales increases quadratically with film thickness ($\lambda \propto h^2$) in agreement with thin-film hydrodynamic theory, this HEA system exhibit a significant deviation from classical instability behaviour. Furthermore, morphological transition in the intermediate nanostructures from bicontinuous shapes to polygons with film thickness (between 9 to 12 nm) further cements role of thermal and mass transport during the nanosecond laser dewetting.

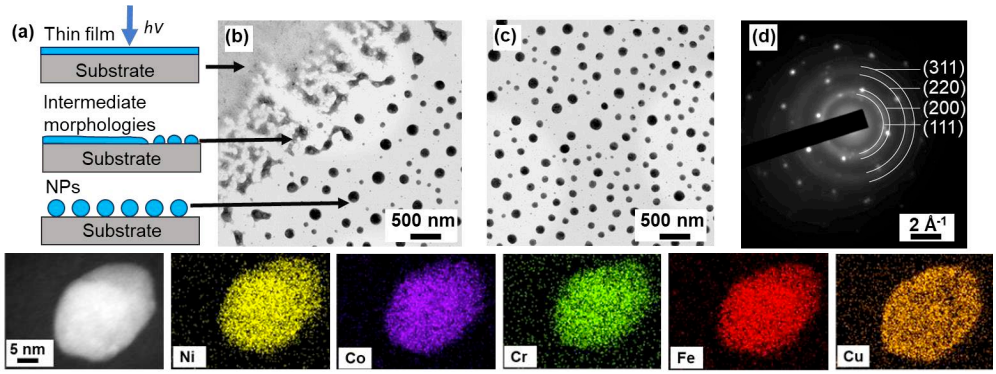

Figure 1 (a) Schematic showing Pulsed laser-induced dewetting (b) Low magnification TEM showing the film, intermediate morphologies and NPs. (c) TEM image showing the nanoparticles formed by pulsed laser-induced dewetting (d) SAED pattern of a single nanoparticle (e) Elemental map showing the spatial distribution of constituent elements in a single nanoparticle.

Machine Learning-Enhanced Atomic Insights into Strain Accommodation and Epitaxial Stabilization of $Ba(ZrSnTiHfNb)O_3$ High-Entropy Oxide Thin Films

Ramji Subedi, Vikas Reddy Paduri, Ritesh Sachan

High-entropy oxides provide a versatile platform for tuning structural and functional properties through extreme compositional disorder. Here, we report the epitaxial growth and misfit-strain accommodation of $Ba(ZrSnTiHfNb)O_3$ high-entropy oxide thin films deposited on SrTiO3 (001) substrates using pulsed laser deposition. By integrating machine learning techniques to enhance atomic-level understanding, we analyze X-ray diffraction ϕ-scans and reciprocal space mapping, confirming four-fold in-plane symmetry and epitaxial stabilization of the perovskite phase. Despite a large lattice mismatch (>6%), the films exhibit epitaxial with relaxed growth while maintaining a single-phase structure. Atomic-resolution imaging and Energy-dispersive X-ray spectroscopy—interpreted via data-driven computational refinement—reveal a sharp film–substrate interface, uniform elemental distribution, and strain relaxation accommodated by Domain Matching Epitaxy with periodic dislocations. These findings demonstrate how large lattice mismatches are accommodated in epitaxial high-entropy perovskite thin films while maintaining crystallinity, providing a foundation for understanding strain relaxation and defect formation in high-entropy systems. This study, supported by machine-learning-aided insights, facilitates future research on advanced oxide-based device applications.

Abstracts - Poster Presentations

Variation in leaf functional traits related to water conservation and heat regulation in Quercus macrocarpa

Leah Hill, Heather McCarthy lab

Abstract
Human-induced environmental changes are increasing water and temperature stress in populations of plants, which can lead to potential extinction if they are unable to adjust. While some plants are capable of adapting to these changing conditions, others lack this resilience. Our research organism, *Quercus macrocarpa,* is a keystone species that has high phenotypic plasticity and a large native range, making it an excellent reference species for investigating local environmental adaptation. Despite oak trees playing a significant role in the global environment, there is still great uncertainty about the limits of their phenotypic plasticity and how well they will perform under rapidly changing conditions. In this study, we investigated leaf traits relevant to water-use efficiency and temperature regulation of *Q. macrocarpa* in Oklahoma, which is one of the hottest and driest areas of its range. Acorns of Q. macrocarpa were sourced from three different states: Oklahoma, Illinois, and Minnesota, and subsequently planted together in a common garden in Oklahoma. To assess how these different populations perform in the Oklahoma climate, microscopic leaf traits were examined using scanning electron microscopy, focusing on stomatal and trichome characteristics due to their roles in regulating gas exchange and leaf temperature in plants. Significant population-level differences were observed in both these traits. Oklahoma-sourced trees displayed greater stomatal density compared to both Illinois and Minnesota populations, while stomatal size remained relatively consistent across all populations. Furthermore, trichome density was significantly lower in the trees from Oklahoma compared to the trees from Illinois and Minnesota, with trichome morphology and classification also varying among the populations. As greater stomatal density generally results in more precise control of water loss and fewer trichomes can contribute to lower leaf temperatures, these results are consistent with greater heat and drought stress tolerance in Oklahoma trees, potentially enhancing their fitness under future climate change.

Keywords: Local adaptation, water use-efficiency, leaf functional traits, trichomes, stomata, climate change

Microscopy-Based Insights into Interfacial Degradation of Interlayer-Reinforced 3D Printed Cementitious Elements

Sijan Adhikari, Shreya Vemuganti

School of Civil Engineering and Environmental Science, University of Oklahoma, Norman, Oklahoma 73019

Abstract

Weak interlayer bonding in extrusion-based 3D-printed concrete increases the vulnerability of tensile reinforcement to chemical degradation, particularly under chloride exposure. This study examines the effects of chemical ingress on the mechanical and microstructural behavior of layered cementitious elements incorporating steel, glass, and carbon fiber-reinforced polymer interlayer reinforcement. 3-D printed beam specimens and their behavior when exposed to NaCl-acidic solution for 60 and 90 days were studied, and light microscopy (Keyence VHX-7000 ultramicroscope) was used to inspect the bond between the reinforcement fabric and the hardened mix, followed by flexural testing. Finally, the failure mechanism was inspected again using light microscopy. Microscopy confirmed that failure mechanisms vary significantly with reinforcement type and exposure conditions, primarily governed by interfacial behavior at ettringite formation, which aids early hydration; its delayed formation under chemical exposure accelerates deterioration and weakens the matrix. Observations from the failed specimen, which was then manually peeled off, as shown in Figure 1.

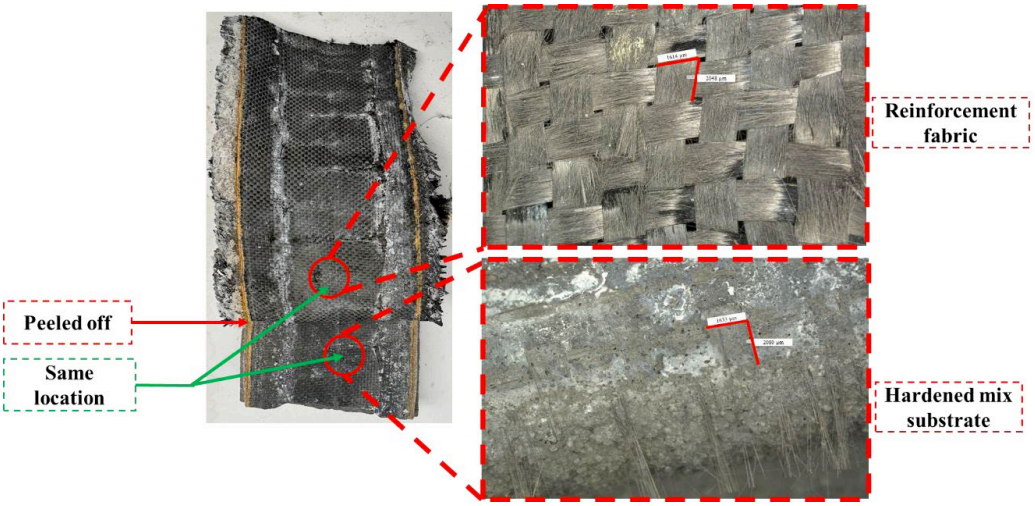

Figure 1: Microscopic investigation of manually peeled CFRP fabric reinforcement from the hardened mix substrate.

This provides clear evidence of a robust bond between the reinforcement and hardened substrate. This is demonstrated by the presence of reinforcement fibers deeply embedded and firmly attached to the hardened substrate, even after the failure. A brownish-yellow deterioration layer was also visible on the peeled reinforcement, indicating that this degradation did little to prevent salts from penetrating much deeper into the mid-section of the beam.

Label-Free Visualization and Quantification of Intracellular Gold Nanoparticles Using Customized Light Scattering Filter Cubes on a Widefield Microscope

Jeesoo Park[1], Vinit Sheth[1], Stefan Wilhelm[1,2,3*]

[1] Stephenson School of Biomedical Engineering, University of Oklahoma, Norman, Oklahoma, 73019, USA
[2] Stephenson Cancer Center, Oklahoma City, Oklahoma, 73104, USA
[3] Institute for Biomedical Engineering, Science, and Technology (IBEST), Norman, Oklahoma, 73019, USA
*Corresponding author: Stefan Wilhelm, Ph.D.
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Abstract

In this study, we demonstrate a label-free approach for visualizing metallic nanoparticles in biological systems. We customize a light scattering detection filter cube and use Keyence BZ-810 widefield microscope to visualize and quantify intracellular AuNPs. This method does not require fluorescent labeling. We then compare this microscope with a Zeiss LSM 780 confocal laser scanning microscope (CLSM) in terms of sensitivity and resolution. We show the versatility of this microscope by examining AuNPs of different sizes, surface modification, and cell lines. Furthermore, we demonstrate that multiple filter cubes at different wavelengths, as well as membrane dyes with distinct excitation spectrum profiles, can be used to detect light scattering from AuNPs. Finally, we performed live-cell imaging to assess phototoxicity of the inherent light sources over a prolonged period and to monitor cellular uptake dynamics in real time. These results demonstrate that widefield microscopy serves as a cost-effective and widely accessible platform for label-free nanoparticle imaging, offering broad applicability across diverse biological environments.

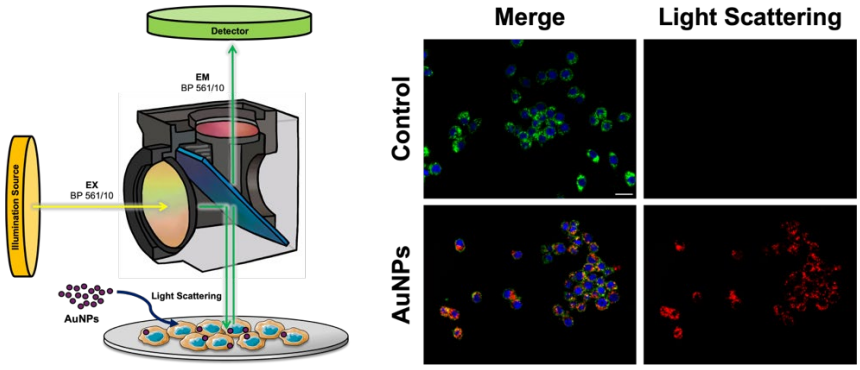

Figure 1. Schematic illustration of the light scattering filter cube system and representative micrographs of RAW264.7 cells without (control) and with intracellular gold nanoparticles (AuNPs). Scale bar = 20 μm.

Employing Expansion Microscopy to Monitor Nanoparticle Spatiotemporal Distributions in Ovcar8 Ovarian Cancer Spheroids

Henley Calhoun[1*], Connor Baroody[1], Vinit Sheth[1], Mobina Mohammadnejad[1], Ahmed Eissa[1], Stefan Wilhelm[1]

[1]Stephenson School of Biomedical Engineering, University of Oklahoma, Norman, 73019, OK
[*]Contact: henleycalhoun@ou.edu

Abstract
In the United States, an estimated 21,010 women are to be diagnosed, and 12,450 women are to die from ovarian cancer in 2026, so there is a need to explore safer and more effective treatments. In this study, we focus on gold nanoparticles as a model system for ovarian cancer nanomedicines. Using 3D super-resolution microscopy, we track the spatiotemporal distribution of these nanoparticles in multicellular OVCAR8 ovarian cancer spheroids. The spheroids were exposed to nanoparticles in cell culture for up to seven days. After fixation, the spheroids were infused and polymerized with swellable hydrogels. Next, the spheroid-hydrogel hybrids were stained with fluorescent NHS-dyes to label the proteome of the spheroids. Upon submerging the stained hybrids in deionized water, we achieved expansion factors of up to 10 times via hydrogel swelling. This expansion process enables the 3D super-resolution microscopy of entire OVCAR8 spheroids with lateral resolutions approaching ~20 nm using conventional confocal laser scanning microscopy systems. Using this workflow, we track the time-dependent accumulation of gold nanoparticles in OVCAR8 spheroids with 3D intracellular context. We hypothesize that most of the internalized gold nanoparticles will actively interact with ovarian cancer cells instead of passively distributing across the extracellular matrix. Additionally, we hypothesize that gold nanoparticles are more likely to reach the spheroid center when incubated for longer. Our research shows the importance of using 3D cancer model systems with in vitro tumor environments that more closely mimic those found in humans, and combining these cancer models with 3D super-resolution microscopy. Our approach may serve as a workflow for evaluating nanoparticle-tumor interactions across various malignancies, with the goal of developing next-generation cancer nanomedicines that are safer and more effective.

Acknowledgments
This work has been supported in part by NSF CAREER (2048130), NIH R35 MIRA (R35GM150758), ACS- DICR Post Baccalaureate Fellows Program (DICR POST-BACC-23-1156971-01) from the American Cancer Society, the Oklahoma Center for Adult Stem Cell Research (OCASCR, equipment grant), and the OU Vice President for Research and Partnerships (SEIP grants).

Orientation-Microscopy Assisted Grain Boundary Engineering of Protonic Ceramic Fuel Cell Electrolytes

S. Patel[a], S Goswami[b], P. Paul[b], F. Liu[c], C. Duan[d], J. Sabisch[e], H. Paik[b,f], T. Venkatesan[b] , P. Kazempoor[a], I. Ghamarian[a]

a. School of Aerospace and Mechanical Engineering, University of Oklahoma, Norman, OK
b. Center for Quantum Research and Technology, University of Oklahoma, Norman, OK
c. Idaho National Lab, Idaho Falls, Idaho, ID
d. Department of Chemical Engineering, University of Utah, Salt Lake City, UT
e. Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK
f. School of Electrical and Computer Engineering, University of Oklahoma, Norman, OK

Abstract

Grain boundaries in protonic ceramic fuel cell (PCFC) electrolytes impede proton transport, significantly reducing conductivity at these interfaces. To address this, grain boundary engineering (GBE) has emerged as a promising approach to enhance material performance by manipulating grain boundary characteristics. However, effectively applying GBE to optimize proton conductivity requires a comprehensive understanding of grain boundary character and population in PCFC materials, which presents inherent challenges due to the vast grain boundary character space.

Combinatorial Thickness-Graded Film Growth via Substrate Tilt Geometry in Pulsed Laser Deposition

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Abstract
Pulsed laser deposition (PLD) is a well-established method for synthesizing thin films, enabling precise control over-growth parameters while maintaining stoichiometry across the specimen. Integrating PLD with combinatorial studies offers a significant advantage for conducting high throughput experiments, thereby accelerating discovery. In this work, we introduce a reliable and reproducible approach for combinatorial thin-film synthesis that features spatially controlled thickness gradients on a substrate, achieved using a tilt-enabled stage. This technique exploits the angular distribution of the laser plume on a tilted substrate, which creates varying distances between the plume source and the substrate, resulting in a thickness gradient. While conventional PLD typically produces a plateau-shaped thickness gradient over large wafer-scale areas due to the natural profile of the ablation plume, our study aims to develop a fundamental understanding of how to create controlled thickness gradients. Using boron nitride (BN) as the model system, we investigate the effect of substrate tilt angles on the spatial distribution of thickness. Atomic force microscopy measurements show that a uniform film forms over a 10 mm × 10 mm area of the substrate at 0° tilt. In contrast, substrate tilt angles of ±20° result in a linearly graded film thickness that is asymmetric around the laser plume axis over the same area. We have extended this study to Co and NiCoCr films, which consist of elements with similar atomic numbers to minimize atomic-number-dependent variations during deposition, thereby improving the reproducibility of our approach across different material systems. Using a model having cosine-power dependency that incorporates target substrate spacing, tilt geometry, and small-axis offsets, we simulate the ablation plasma plume profile to understand film thickness profiles for both 0° and tilted substrate geometries. The results agree with our experimental findings and provide guidance for designing combinatorial experiments that require film thickness gradients.

Keywords: Pulsed laser deposition, Combinatorial thin films, Boron nitride, Plasma plume simulation, Graded films.

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Label-Free and High-Throughput Quantification of Nanoparticle-Cell Interactions at the Single-Cell Level with Flow Cytometry

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Abstract

Understanding nanoparticle–cell interactions at the single-cell level is essential for designing next-generation nanomedicines. Here, we explore flow cytometry as a single-cell technique for the label-free quantification of nanoparticle–cell interactions and integrate it with advanced optical imaging approaches. We demonstrate that conventionally used side-scattering signals can be leveraged to quantify interactions between nanoparticles and individual cells, and corroborate these findings using confocal laser scanning microscopy, expansion microscopy-based optical super-resolution imaging, and elemental mass spectrometry. Using gold and silver nanoparticles with varying sizes, compositions, and surface chemistries, we show that side-scatter signals sensitively capture differences in nanoparticle–cell interactions across multiple conditions, including concentration-dependent responses and interaction kinetics. High-resolution microscopy further reveals nanoparticle localization within intracellular compartments, supporting the interpretation of scattering-based measurements and confirming nanoparticle internalization and trafficking. Since single-cell super-resolution microscopy of cell populations is limited in throughput, flow cytometry provides an elegant, high-throughput approach to analyze thousands of single cells per minute to corroborate microscopy results. Extending this approach to mixed-cell and co-culture models, we capture nanoparticle–cell interactions in more physiologically relevant and heterogeneous cellular environments. Our workflow establishes a framework for the systematic single-cell analysis of nano–bio interactions to advance the rational engineering of next-generation nanomedicines.

Computational Molecular Spectroscopic Imaging for Biomedical Applications

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Abstract
There is an urgent need to develop new optical imaging methods to address key challenges in neurodegenerative disease and fundamental neuroscience research. In neurodegenerative research, tauopathy has emerged as a central focus, requiring detailed characterization of the morphological and chemical structures of tau aggregates. However, noninvasive, subcellular imaging of these intracellular protein aggregates remains challenging, particularly when aiming to resolve their protein secondary structures in 3D and in situ. In systems neuroscience, optically transparent and genetically tractable model organisms such as jellyfish have facilitated studies of neural regeneration, plasticity, and neural network organization. Yet, despite these advantages, capturing neural dynamics in living animals requires imaging capabilities with video-rate 3D imaging speed and millimeter-scale fields of view, posing a significant technical challenge. Here, we report our progress in computationally enhanced chemical and fluorescence microscopy methods designed to overcome these challenges. First, we introduce our fluorescence-guided infrared photothermal chemical microscope, which enables bond-selective, hyperspectral, in situ 3D imaging of intracellular tau aggregates and their secondary protein structures. We also highlight our ongoing research toward achieving video-rate, millimeter-scale, 3D in vivo imaging of neural activity in model organisms.

Development of Electric Organ and Ontogenetic Transition of EOD Waveforms, the Challenge Faced by Larval Weakly Electric Fish.

Donglin Han, Tingting Gu and Michael Markham

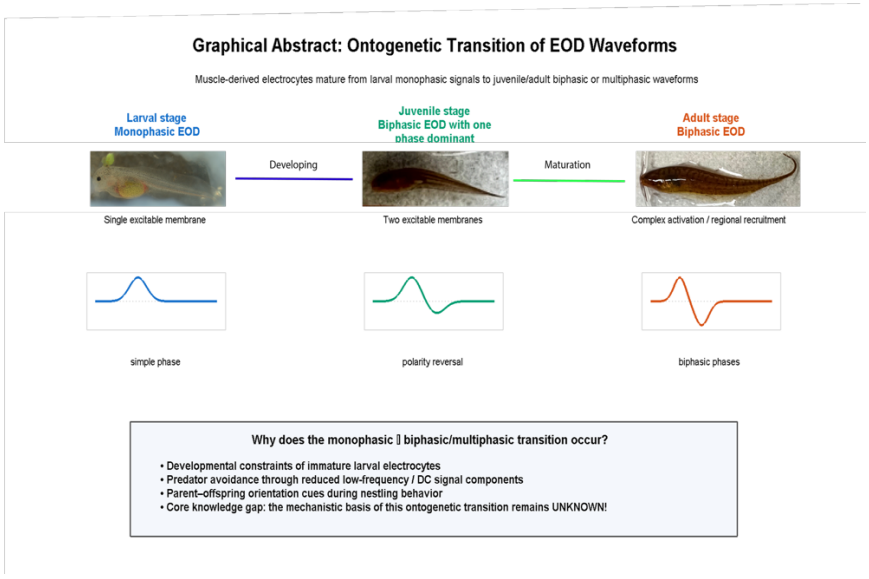
Abstract

Weakly electric fish generate and sense electric organ discharges (EODs) to navigate and communicate in visually limited environments. In many gymnotiform fish, larvae initially produce simple monophasic electric signals that later transition into biphasic or multiphasic waveforms as individuals mature. This ontogenetic transition coincides with the development and maturation of the electric organ (EO), which arises from muscle-derived precursor cells that differentiate into specialized electrocytes capable of generating synchronized electrical activity.

Here we review current knowledge on the evolution, development, and physiology of electric organs, with a particular focus on emergence of larval electric organs and the developmental transition of EOD waveform from monophasic to biphasic. Early electrocytes produce a monophasic discharge from a single electrically excitable membrane. As development proceeds, electrocytes undergo morphological and physiological modifications, including the acquisition of additional excitable membranes, changes in ion channel distribution, and increasingly coordinated activation across the electric organ, leading to the biphasic EOD waveforms.

Despite decades of research on electric fish neurophysiology and signal diversity, the mechanisms driving this ontogenetic waveform transition remain poorly understood. Several hypotheses have been proposed, including developmental constraints on immature larval electrocytes, ecological benefits related to predator avoidance, and potential roles of early signals in parental care and larval orientation. However, experimental evidence directly linking these mechanisms to waveform development is still limited.

Understanding how simple larval electric signals transform into complex adult communication signals provide a powerful framework for linking developmental biology with sensory evolution.



Microscopic Probing of Excitonic and Structural Dynamics in Molecular Crystalline Thin Films

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Recent advances in microscopic measurements have enabled unprecedented insight into the structure-property relationships of complex molecular systems. Understanding the coupled behavior of photoexcited electron-hole pairs and the rearrangement of the atomic lattice over time in 2D molecular crystalline thin films will result into promising applications in optoelectronics, photonics, and sensing technologies. Our study employs a combination of advanced microscopic and spectroscopic techniques to probe the relationship between molecular arrangement and functional response in array of quadrupolar dye architectures at the nanoscale. Particular concern is given to exciton and structural dynamics, charge transport mechanisms, and the role of heterogeneity, defects and disorder in modulating film properties. We further investigate how external tuning parameters such as film thickness, substrate interaction, temperature and chemical environment influence controlled property optimization. Our findings reveal how recent innovations in microscopic measurement techniques provide a potential platform for resolving structure-function relationships in complex molecular films.

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SARS-COV2 GENES FUNCTIONALLY INTERACT WITH HUMAN PAPILLOMAVIRUS ONCOPROTEIN E6

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High-risk human papillomaviruses (HR-HPVs), particularly types of HPV 16 and 18, drive nearly all cervical cancers, and a significant number of vaginal, vulvar, penile, and oropharyngeal cancers through the persistent expression of HPV viral oncogenes E6 and E7. Although HPV vaccines are available, due to the long latency period, low vaccination rate, and the lack of molecularly targeted drugs for early treatment, the incidence of HPV-associated cancers continues to rise. Therefore, understanding the mechanisms of HPV-induced tumorigenesis is critical for developing new and effective strategies to prevent and treat the disease. Recently, synergistic activities between HPV and Sars-CoV2 have been reported, and it is shown that cervical intraepithelial neoplasia and the epithelial cells of oral mucosa have the factors necessary for Sars-CoV2 infection. However, no study to date has investigated the functional interaction between the two viruses and its impact on disease progression. Understanding these interactions is crucial for identification of actionable drug targets to eliminate coinfected cells. In this study, we investigated functional interaction between HPV and Sars-CoV2 genes using transgenic *Drosophila* (the fruit fly) expressing HPV and Sars-Cov2 genes. Using a Gal4-UAS binary expression system to direct gene expression in desired tissue, we performed a functional genetic screen to identify Sars-CoV2 genes whose expression modified E6 oncogene-induced defects. We found that from all Sars-CoV2 genes examined, only nsp3, nsp6, ORF6, and ORF3a were able to modify E6-induced defects, suggesting a functional interaction. Further examination revealed that Sars-CoV2 genes, nsp3 and ORF3a, were both proapoptotic and when expressed in conjunction with E6, disrupted the pro-survival function of E6, promoting apoptotic cell death. Conversely, nsp6 and ORF6 were not proapoptotic when expressed alone, however, similar to nsp6 and ORF6, they interfered with the anti-apoptotic function of E6. These results suggest that Sars-CoV2 and HPV functionally interact and promote cellular and morphological abnormalities that are distinct from those induced by each of these viruses individually. We are currently investigating the mechanism that underlie these interactions to identify druggable targets that can be exploited for development of targeted therapies to eliminate HPV/Sars-CoV2 coinfected cells.

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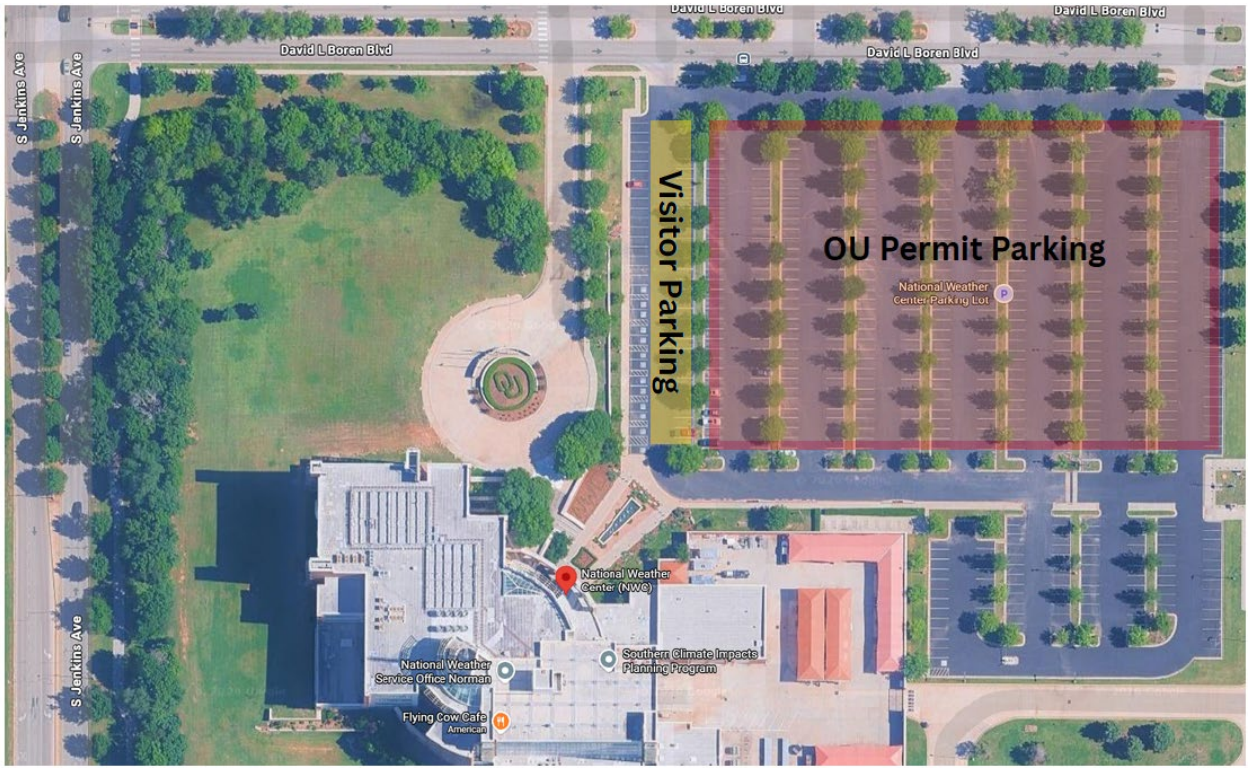

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