Schedule

8:00 – 9:00 Registration, Breakfast

9:00 – 9:45 *Construction of Exotic Nanoparticles: Polymer and Peptide Assembly as followed by cryoTEM*, **Darrin Pochan**, Professor of Materials Science and Engineering, University of Delaware

9:45 – 10:30 *Advances in volumetric imaging with super-resolution light microscopy and serial block-face scanning electron microscopy,* **Jeffrey Caplan**, Associate Professor and Director Bioimaging Center Department of Plant and Soil Sciences, University of Delaware

10:30 – 11:00 Break

11:00 – 11:45 *A spiny tale: Functional Morphology of marine invertebrate larvae,* ***Karen*** **Chan**, Assistant Professor of Marine Biology, Swarthmore University

11:45 – 1:00 Lunch

1:00 - 1:45 *Use of Correlative Approaches in Cultural Heritage,* **Thomas Lam**, Ph.D. Physical Scientist, Smithsonian Museum Conservation Institute

1:45 – 2:30 Student Talks

Noble Metal Chalcogenide Dual Plasmonic Hetero-nanoarchitectures,

Mariia Ivanchenko, Graduate Research Assistant, George Mason University

The Devil worm's efficient mitochondria: Adaptation of H. Mephisto's electron transport chain in extreme conditions, **TreVaughn Ellis**, American University

2:30 – 3:00 Break

3:00 – 3:45 *Atomic Force Microscopy: A Versatile Tool to Interrogate Biological Tissue Function, Disease and Regeneration,* **Lin Han,** Associate Professor in the School of Biomedical Engineering, Science and Health Systems at Drexel University

3:45 – 5 Tours (tours of the Keck Laboratories and the Mineral Museum will be available)

Speaker 1: Professor Darrin Pochan

Title: *Construction of Exotic Nanoparticles: Polymer and Peptide Assembly as followed by cryoTEM*

Professor of Materials Science and Engineering, University of Delaware

Abstract:

Biography:

Dr. Pochan received his B.S. in Chemistry at the University of Wisconsin. He earned his Ph.D. at the University of Massachusetts under the tutelage of Professor Sam Gido. He currently is Professor of Materials Science and Engineering at the University of Delaware. He has a joint appointment as Professor of Chemistry and Biochemistry also at the University of Delaware.

Dr. Pochan`s group is exploring vesicle, micelle, and hydrogel formation in dilute aqueous systems of block polypeptides. This work is coupled with solid-state block polypeptide characterization and block polypeptide-protein blend morphology studies to establish the self-assembly rules for these novel synthetic materials. In addition, Dr. Pochan is studying the self-assembly of unique polymeric and organic-inorganic hybrid materials in bulk and for pattern formations in thin films. Other research interests focus on novel bulk structure and pattern formation via competing phase transitions in hybrid dentritic/linear polymer materials. Experimental techniques frequently used include small and wide-angle x-ray and neutron scattering, transmission and scanning electron microscopy, and atomic force microscopy.

Speaker 2: Professor Jeffrey Caplan

Associate Professor and Director Bioimaging Center Department of Plant and Soil Sciences, University of Delaware

Title: *Advances in volumetric imaging with super-resolution light microscopy and serial block-face scanning electron microscopy*

Abstract:

Biography:

Dr. Caplan received B.S. degrees in Molecular and Cellular Biology and in Horticulture at the University of Connecticut. He earned his Ph.D. at Yale University in Molecular, Cellular, and Developmental Biology at Yale University.

Dr. Caplan is Associate Professor of Plant and Soil Sciences at the University of Delaware Biotechnology Institute. Dr. Caplan is the Director of the Bioimaging Center at the University of Delaware Biotechnology Institute.

The research in the Caplan lab focuses on the role of organelle dynamics during plant innate immunity. Specifically, they are interested in how and why chloroplasts dramatically change their morphology by sending out stroma-filled tubules called “stromules.” They are studying their function during chloroplast movement and localized release of signals, such as reactive oxygen species (ROS), during innate immune responses to pathogens.

The other focus of his lab is the development of novel microscopy methods using a variety of model systems, that includes bacteria, fungi, mammalian cell lines, and plants. Currently, we are creating methods for live-cell small RNA detection, quantitative super-resolution RNA imaging, deep learning image analysis, and plant tissue clearing.

Speaker 3: Professor Karen Chan

Assistant Professor of Marine Biology, Swarthmore University

Title: A spiny tale: Functional Morphology of marine invertebrate larvae

Abstract:

Many marine organisms have complex life histories and rely on the small planktonic larval stage for dispersal. Despite their small size, planktonic larvae are not passive particles. Instead, they actively respond to various cues and navigate the water column. Living in a low Reynolds number regime, where viscous force dominates, swimming behaviors are in turn constrained by the morphology of the organisms. Using numerical and dynamically scaled models informed by details micrographs, we examine the role of body extension in swimming, feeding, and predator avoidance of crustaceans larvae. Our work highlights the link between form and function and the evolutionary constraints of biomechanics.

Biography:

Karen Chan is a biological oceanographer studying the interaction between plankton and their fluid environment. She is currently an Assistant Professor in the Department of Biology at Swarthmore College. She received her BSc (Hons) from the University of Hong Kong and completed her graduate studies in Oceanography at the University of Washington. She worked as a Coastal Ocean Institute and Croucher Foundation Postdoctoral Fellow at the Woods Hole Oceanographic Institution before joining the faculty at the Hong Kong University of Science and Technology.

Speaker 4: Thomas Lam, Ph.D.

Physical Scientist, Smithsonian Museum Conservation Institute

Title: *Use of Correlative Approaches in Cultural Heritage*

Abstract:
Within cultural heritage, correlative imaging approaches are tools are commonly applied. This can apply to cases when samples are limited in size (to keep objects intact) or to correlate microanalysis with the bulk characterization. Examples of correlative microanalysis with limited sample size will be presented for paint cross sections to study Zn soap formation and early European porcelains. Example of correlative microanalysis (SEM-EDS and µXRF) to corelate to with the bulk characterization (XRF and color analysis) will be presented for jadeites and stamps.

Biography:
Thomas Lam has a Ph.D. in Ceramics from Alfred University. After his Ph.D, Thomas completed a postdoc at the National Institute of Standards and Technology (NIST). Thomas is a Physical Scientist at the Smithsonian Museum Conservation Institute (MCI), where he applies his knowledge of material science and characterization skills of scanning electron microscopy electron dispersive spectroscopy (SEM-EDS), cathodoluminescence (CL), X-ray fluorescence (XRF), or microfade testing (MFT) to contribute to the MCI technical studies team.

Speaker 5: **Mariia Ivanchenko**

Graduate Research Assistant, George Mason University

Title: *Facile aqueous synthesis of hollow dual plasmonic hetero-nanostructures with tunable optical responses through nanoscale Kirkendall effect*

Abstract:
Multicomponent plasmonic nanoparticles, especially structurally well-defined noble metal-nonstoichiometric copper chalcogenide dual plasmonic hybrid hetero-nanostructures, have emerged as an intriguing platform of superstructures due to their synergistically reinforced optical properties. The integration of two intrinsically dissimilar plasmonic constituents in one nano-entity empowers us to explore many new-yet-unexpected features, holding tremendous potential for plasmon-mediated energy transfer, plasmon-enhanced photocatalysis, and plasmon-related photothermal and photodynamic theranostics. We report the colloidal synthesis of hollow dual-plasmonic nanoparticles using Au@Cu2O core−shell NPs as templates and exploiting the nanoscale Kirkendall effect, which is a nonreciprocal interdiffusion process through an interface between two materials with strikingly different atomic diffusivities. The resulting structures possess different features depending on the chalcogenide precursor employed. TEM images confirm the complete transformation of Au@Cu2O templates when 1,1-dimethyl-2-selenourea was added and the formation of hollow Au@Cu2−xSe nanostructures. In contrast, residues of Cu2O attached to the Au core were present when thioacetamide was used for the synthesis of Au@Cu2−xS with all other conditions kept the same. The divergence of architectures caused distinct optical properties of Au@Cu2−xS and Au@Cu2−xSe NPs.

Biography:
Mariia Ivanchenko received her M.S. in Physical Chemistry from Taras Shevchenko National University of Kyiv in 2015. Currently, she is a doctoral candidate working in Nanosynthesis, Optics, and Energy Lab (NOEL) at Department of Chemistry and Biochemistry, George Mason University under the supervision of Professor Hao Jing. Her current work focuses on colloidal synthesis and characterization of plasmonic nanomaterials.

Speaker 6: TreVaughn Ellis

Title: *The Devil worm's efficient mitochondria: Adaptation of H. Mephisto's electron transport chain in extreme conditions*

Abstract:
Halicephalobus mephisto is a subterrestrial worm found 1.3 kilometers underground in hypoxic, high-temperature conditions. It can thrive without connection to the surface and has been shown to contain a genomic signature for stress adaptation. Because this organism can survive oxygen levels 10-30 times lower than surface water, we hypothesize that its mitochondrial respiration has also adapted. Oxygen interacts with Complex IV of the electron transport chain, where it serves as the terminal electron acceptor, producing water and actively transporting protons across the membrane to establish the mitochondrial proton gradient. Tetramethylrhodamine, ethyl ester (TMRE) measures the mitochondrial proton gradient directly. In this study we utilized TMRE to compare *C. Elegans* and *H. Mephisto*'s mitochondrial proton gradient in the presence and absence of Sodium Azide, a Complex IV inhibitor. The data suggests that *H. Mephisto* has evolved a more efficient Complex IV proton pump.

Biography:
Trevaughn is an undergraduate junior at American University. He is majoring in Biology with a minor in environmental science. He intends to pursue a doctorate in marine microbiology. He is interested in cnidarians such as corals and anemones.

Speaker 7: **Professor Lin Han**

Associate Professor in the School of Biomedical Engineering, Science and Health Systems at Drexel University

Title: *Atomic Force Microscopy: A Versatile Tool to Interrogate Biological Tissue Function, Disease and Regeneration*

Abstract:

Osteoarthritis is the most prevalent musculoskeletal disease, afflicting more than 15% of the general population. The development of effective treatment and regenerative strategies is challenged by our limited understanding of the molecular activities that govern the assembly and degradation of articular cartilage and its extracellular matrix (ECM). To address this limitation, we developed an array of atomic force microscopy (AFM)-based nanomechanical tools to quantify the phenotypic defects of articular cartilage ECM resulted from genetic ablation or disease progression, and to uncover the underlying molecular mechanisms. Using these tools, we discovered a crucial role of the small proteoglycan, decorin, in the function of cartilage ECM and pathology of OA. Applying AFM-based nanoindentation to cartilage of decorin-null mice in physiologic-like conditions, we found that loss of decorin resulted in a substantial reduction of tissue modulus. Next, we custom-built an AFM-based nanorheometric test, which enabled us to quantify the time-dependent, energy dissipative micromechanics of murine cartilage at nm-scale deformation amplitude over four decades of frequencies (1 to 1,000 Hz). Applying this modality, we showed that loss of decorin also impaired the shock absorption function of cartilage, as marked by the elevated tissue hydraulic permeability. Furthermore, we found that such defects are due to the reduced content of aggrecan, the major proteoglycan of cartilage ECM caused by the loss of decorin. Applying AFM-based molecular force spectroscopy and tapping mode imaging, we confirmed that decorin regulates the retention of aggrecan in cartilage ECM by providing physical linkage to increase the molecular adhesion of aggrecan-aggrecan and aggrecan-collagen II fibrils. Given the high sensitivity of cartilage chondrocyte cells to their microenvironment, we then queried the impact of decorin loss on the integrity of pericellular matrix (PCM), the aggrecan-rich microlayer immediately surrounding chondrocytes. Applying immunofluorescence (IF)-guided AFM nanomechanical mapping to cryo-sections of murine cartilage, we showed that loss of decorin leads to reduced PCM micromodulus, which in turn, disrupts chondrocyte intracellular calcium signaling in situ. When these decorin-deficient mice are subjected to destabilization of the medial meniscus (DMM) surgery, an in vivo model of post-traumatic OA, they developed accelerated cartilage fibrillation and further reduction of tissue modulus, illustrating a crucial role of decorin in OA pathology. Taken together, these results highlighted an indispensable role of decorin in governing the biomechanical function and mechanobiology of cartilage by regulating the molecular assembly of ECM. Outcomes also illustrated the potential of AFM-based nanomechanical tools in uncovering novel molecular mechanisms that regulate biological tissue assembly and disease, yielding new targets for developing disease intervention and regeneration strategies.

Biography:

Dr. Lin Han is an associate professor in the School of Biomedical Engineering, Science and Health Systems at Drexel University. He obtained Ph.D. degree at MIT in 2007. His Ph.D. thesis focused on the molecular, cellular and tissue nanomechanics of cartilage. He later worked as a post-doctoral associate at MIT, where he continued the exploration of nanostructure and nanomechanics of soft and hard biological tissues. His current research focuses on understanding the structural and mechanobiological roles of extracellular matrix collagens and proteoglycans, as well as their applications in tissue regeneration and disease treatment. Specifically, his lab studies the roles of small proteoglycan, decorin, and regulatory fibril-forming collagens, types V and XI, in the formation, degeneration and regeneration of cartilage, meniscus and temporomandibular joint.