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2026 Fall Meeting Hudson Mohawk AVS Chapter

Tuesday, October 27, 2026

2:40 – 7:20 PM

University at Albany, SUNY
ETEC building, Room B010
1220 Washington Avenue, Albany, NY 12226

Meeting Agenda

2:40 - 3:10 Reception (*coffee and cookies served*)

3:10 - 3:20 Welcoming Remarks by Vincent Smentkowski

Keynote Presentation

3:20 - 3:50 "Engineering New Physics with Nanojunctions – Chemical Sensors to Quantum Emitters"

Prof. Brian Willis, Dept. of Chemical and Biomolecular Engineering,
University of Connecticut

3:50 - 4:00 Break

Oral Presentations

4:00 - 4:15 "Multiscale Modelling of Atomic Layer Etching of GaN in Cl₂/Ar Plasmas"
Tojo Rasoanarivo (UAlbany CNSE, Post-Doc)

4:15 - 4:30 "Epitaxial Growth of CoSn(10 $\bar{1}$ 0) Thin Films"
Ethan Hendrix (RPI, MSE, Graduate Student)

4:30 - 4:45 "Hypulse XPS - Depth Profiling using Femtosecond Laser Ablation (fs-LA) for Polymer Materials"
James Lallo (Thermo Fisher Scientific)

4:45 – 5:00 "Intelligent Sensor Arrays for Chemical Vapor Detection in Humid Environment"
Md Delowar Hossain (UConn, Graduate Student)

5:00 - 5:15 "Surface and Bulk Characterization of Organic Semiconductors Using XPS And UPS Techniques"
David Surman (Kratos Analytical)

5:15 - 5:30 "Molecularly-Induced Colossal Thermal Conductance and Optoacoustic Dampification in Inorganic/Organic Multilayers"
Ankit Kashyap (RPI, MSE, Post-Doc)

5:30 - 5:45 "Prospects for EBIC measurements from lamellae"
Greg Johnson (ZEISS Microscopy)

5:45 - 7:00 **Poster Presentations** (*pizza and refreshments served*)

7:00 - 7:20 **Student Awards Ceremony**

Poster Presentations

P01. ELECTRON TRANSPORT AND THERMAL STABILITY OF EPITAXIAL Rh/Ir/MgO(001) INTERFACES FOR NANOSCALE INTERCONNECTS

Zahra Ahmadian¹ (RPI, MSE, Graduate Student)

P02. VIA-SIZE-DEPENDENT MICROSTRUCTURES OF Cu PADS IN CHIPLETS FOR HYBRID BONDING

Weichang Lin (RPI Physics, Graduate Student)

P03. QUANTITATIVE LIGHT-MATTER INTERACTION IN THE THZ RANGE FOR NEAR-FIELD MICROSCOPY

Lucas Danburg (Fairfield University, Undergraduate Student)

P04. THIN FILM GROWTH OF TOPOLOGICAL SEMIMETAL PdGa

Oishy Roy (RPI, MSE, Graduate Student)

P05. DEVELOPMENT OF ANALYSIS SYSTEM FOR DETERMINING THE DAMPING RATE, RESONANCE FREQUENCY, AND RESISTANCE OF MEMS DEVICES

Alvar Garza (UAlbany, CNSE, Graduate Student)

P06. MOLECULARLY-INDUCED Co NANOFILM WETTING ON LOW-k SiCOH SURFACES

Ankit Kashyap (RPI, MSE, Post-Doc)

Driving Directions

The ETEC building is in the Harriman State Office Complex, which is adjacent to the University at Albany campus. The address of the ETEC building is ETEC, 1220 Washington Avenue, Albany, NY 12226.

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From UAlbany Campus:

There is no direct street access to the ETEC building from the UAlbany campus. You must first drive to either Washington Avenue or Western Avenue and go east towards downtown Albany.

Just after passing the UAlbany campus, there will be an entrance to the Harriman State Office Complex (State Office Buildings).

- If entering Campus Access Road from Washington Avenue, you will see the ETEC building on your left. After passing the building, you will take a U-turn to access the side of Campus Access Road that passes in front of the ETEC building. The parking lot is on the north side of the building.
- If entering Campus Access Road from Western Avenue, you will also need to take a U-turn so that you are driving towards the ETEC building, not away from it. Again, the parking lot is on the north side of the ETEC building.

From the North:

Take the Northway (I-87) south to Exit 1E. Merge onto I-90 east (toward Albany/Boston). Then take Exit 3 (State Office Buildings), which will put you on Campus Access Road. After passing the ETEC building, you will take a U-turn to access the side of Campus Access Road that passes in front of the ETEC building.

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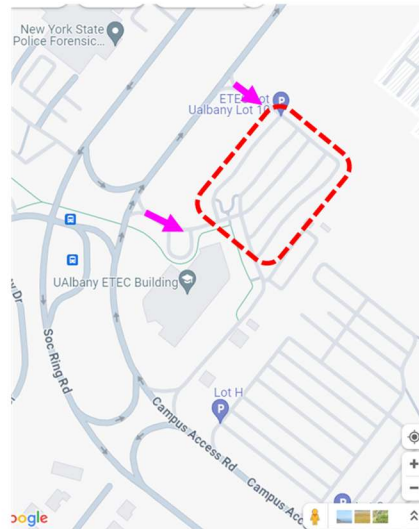
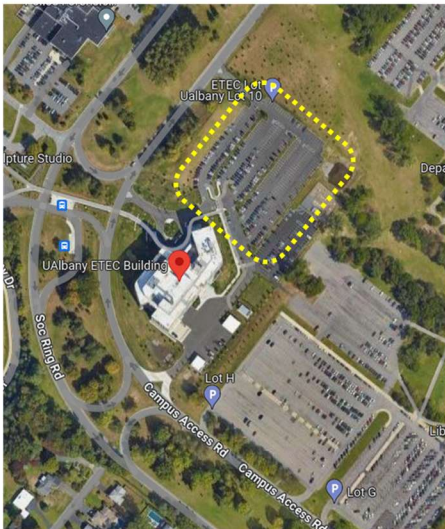
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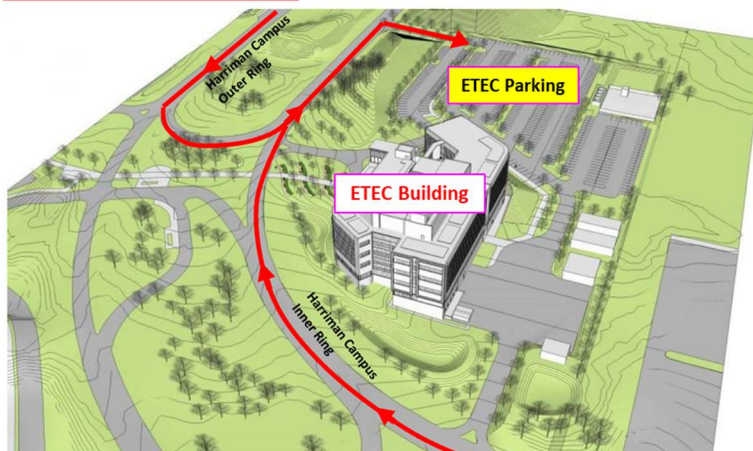
Do not park in any EV charging spots unless charging an electric vehicle.

Enter ETEC Lot from Campus Access Road (inner ring road, one-way)

(Purple Arrows)



From Washington Ave (North)



From Western Ave (US-20, South)

ENGINEERING NEW PHYSICS WITH NANOJUNCTIONS – CHEMICAL SENSORS TO QUANTUM EMITTERS

Prof. Brian Willis

*Department of Chemical and Biomolecular Engineering,
University of Connecticut, Storrs, CT, USA*

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Nanolithography and atomic layer processing developed by the semiconductor industry may enable new types of nanodevices beyond the semiconductor roadmap. Plasmonic nanojunctions are especially interesting for their wealth of new physics that combines photonic, electronic, and molecular functions. Potential device applications include solar energy collection, nanoscale light detectors & light emitters, single molecule spectroscopy, chemical sensors, DNA sequencing, and plasmon-enhanced chemical reactions. In addition, plasmonic nanojunctions combined with quantum dots have applications in quantum computing and quantum communication. While the basic physics of these devices have been demonstrated in the laboratory, making them practical introduces numerous engineering challenges. Harnessing nanojunction phenomena requires high-quality materials, nanoscale geometry control, and sub-nm precision growth. Special process engineering challenges arise when device feature sizes become similar to length scales for thin film nucleation and growth. In this talk we will review nanojunction physics and discuss how atomic layer deposition may be useful to fabricate novel devices if challenges around area-selective nucleation and growth can be overcome.

Keynote Speaker Biography:

Dr. Brian G. Willis is Professor in the Department of Chemical and Biomolecular Engineering at the University of Connecticut (UConn). He earned his B.S. degree in chemical engineering from Northwestern University, Evanston, IL, and the Ph.D. degree in chemical engineering from the Massachusetts Institute of Technology, Cambridge, MA. He started his career as a member of technical staff at Bell Laboratories, Lucent Technologies, followed by an academic position at the University of Delaware. He has been at UConn since 2009 where he is also a Graduate Faculty Member of the Department of Materials Science and Engineering and the Institute of Materials Science at UCONN. His research interests include chemical sensors, nanoscale plasmonic devices, atomic layer deposition, nanofabrication, and surface science.

Keynote Presentation

MULTISCALE MODELLING OF ATOMIC LAYER ETCHING OF GaN IN Cl₂/Ar PLASMAS

T. Rasoanarivo^{1,2}, C. Mannequin¹, I. Braems¹, F. Roqueta², M. Boufnichel², A. Rhallabi¹

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²STMicroelectronics, 10 rue Thalès de Milet, 37100 Tours, France

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Plasma Atomic Layer Etching (ALE) is a cyclic process based on two self-limiting half-reactions separated by purge steps. An ideal ALE cycle consists of an adsorption step that modifies the outermost surface layer, followed by an activation step that selectively removes it while preserving the underlying material. The ALE of GaN using alternating Cl₂ and Ar plasmas for adsorption and activation, respectively, has been extensively studied [1]. These studies indicate that surface modification is driven by chlorine radicals, while etching is controlled through the ion bombardment energy. However, most ALE studies remain experimental, with limited modeling efforts, mainly based on molecular dynamics [2]. Here, we propose a multiscale kinetic model of GaN ALE in chlorinated plasmas. Precursor fluxes are obtained from a dynamic global plasma model [3], while chlorine–GaN surface interactions are investigated using Density Functional Theory (DFT) [4]. Ion bombardment is modeled from the energy and angular distributions induced by the plasma sheath, including ion-induced surface amorphization. These results are coupled to a new kinetic Monte Carlo (kMC) model providing an atomic-scale description of surface evolution [5]. The model quantifies etched depth, surface morphology, surface coverage, and sputtered species throughout the ALE process. This approach enables the simulation of complete ALE processes over experimentally relevant timescales at lower computational cost than molecular dynamics or DFT-based methods. Its applicability to various ALE recipes, including purge-free processes, provides a framework for investigating etching mechanisms and optimizing process conditions.

References

- [1] Mannequin, Vallée, Akimoto, Chevolleau, et al., JVST A, (2020)
- [2] Kounis-Melas, Vella, Panagiotopoulos, Graves, JVST A, (2025)
- [3] Rasoanarivo, Mannequin, Roqueta, Boufnichel, Rhallabi, JVST A, (2024)
- [4] Rasoanarivo, Mannequin, Rhallabi, Roqueta, Boufnichel, Braems, JVST A, (2026)
- [5] Rasoanarivo, Mannequin, Braems, Roqueta, Boufnichel, Rhallabi, JVST A, (2026)

Oral presentation

Post-Doc

EPITAXIAL GROWTH OF CoSn(10 $\bar{1}$ 0) THIN FILMS

Ethan Hendrix¹, Rui Shu¹, Daniel Gall¹

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Hexagonal cobalt-tin (CoSn) exhibits a large resistivity anisotropy and a predicted high conductivity in the limit of thin (<10 nm) wires if the hexagonal *c*-axis aligns with the wire direction¹. In order to exploit its high conductivity, it is essential to develop a thin film deposition process for which the crystalline *c*-axis is in the plane of the thin film. 50 nm thick CoSn(10 $\bar{1}$ 0)/W(211)/MgO(011) layers are deposited by combined DC and high power impulse magnetron sputtering (HiPIMS) in 5 mTorr Ar at $T_s = 500$ °C. The W(211) nucleation layer is 10 nm thick and facilitates nucleation of CoSn in the 10 $\bar{1}$ 0 orientation such that the hexagonal *c*-axis is parallel to the substrate surface, as desired. The CoSn exhibits 3D island growth, leading to a limited surface coverage of only 56%. The surface coverage is increased to 94% by cosputtering Co, Sn, and W (CoSn-W). In this approach, the W reduces the Sn surface diffusion², leading to improved substrate wetting. Scanning electron microscopy, atomic force microscopy and Auger electron spectroscopy elemental mapping are used to study the surface morphology, microstructure, and local composition as a function of CoSn-W film thickness $d = 5$ -75 nm (see Figure 1). X-ray diffraction shows sharp CoSn 10 $\bar{1}$ 0 and W 211 peaks while atomic force microscopy reveals a low roughness of 1.4 nm for $d = 5$ nm but island formation and a resulting large roughness > 7 nm for $d \geq 9$ nm. The resistivity decreases from 42 to 29 $\mu\Omega\cdot\text{cm}$ with increasing $d = 5$ -19 nm. This indicates that CoSn-W films with $d < 9$ nm are promising nucleation layers for continuous CoSn(10 $\bar{1}$ 0) growth.

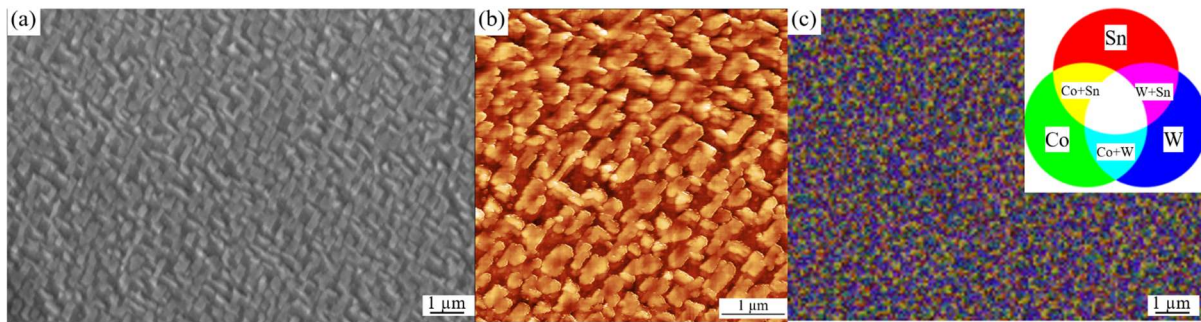


Figure 1. (a) Scanning electron micrograph, (b) atomic force micrograph, and (c) composition map from Auger electron spectroscopy, from a 19 nm thick CoSn-W layer.

¹ S. Kumar, C. Multunas, B. Defay, D. Gall, and R. Sundararaman, "Ultralow electron-surface scattering in nanoscale metals leveraging Fermi-surface anisotropy," *Physical Review Materials* 6(8), (2022).

² S. Chen, C. Yang, L. Tan, Y. Xia, A. Hu, H. Ling, Y. Wu, M. Li, and T. Hang, "Effects of W contents on the solid-state interfacial reactions of Sn/Co-W," *Journal of Materials Science* 57(2), 1403–1415 (2022).

Oral Presentation
Graduate Student

Hypulse XPS - DEPTH PROFILING USING FEMTOSECOND LASER ABLATION (fs-LA) FOR POLYMER MATERIALS

*James Lallo, Thermo Fisher Scientific US; Tim Nunney, Thermo Fisher Scientific UK;
Robin Simpson Thermo Fisher Scientific UK; Paul Mack, Thermo Fisher Scientific UK;*

james.lallo@thermofisher.com

X-ray Photoelectron Spectroscopy (XPS) is a powerful analytical technique for characterizing the surface chemistry and depth-dependent composition of polymers, coatings, and multilayer structures. Understanding the chemistry of these materials at surfaces and interfaces is critical because properties such as adhesion, wettability, barrier performance, durability, and appearance can depend strongly on the composition of the outermost surface or buried interfaces. However, depth profiling polymeric materials using conventional ion beam sputtering can induce significant chemical damage, complicating the interpretation of depth-dependent chemical information.

The Thermo Scientific™ Hypulse™ XPS introduces femtosecond laser ablation as a complementary material removal technique for XPS depth profiling. By reducing the chemical modifications commonly associated with conventional ion beam sputtering, femtosecond laser ablation extends depth-resolved XPS analysis to challenging polymeric materials while also enabling significantly greater analysis depths and faster material removal rates.

This presentation will explore the practical application of Hypulse XPS to polymer surfaces, coatings, and multilayer products encountered in everyday and industrial applications. Examples will include plastic food packaging, paints and polymeric coatings, and architectural window films.

Through these examples, the presentation will demonstrate how surface-sensitive XPS and femtosecond laser depth profiling can be combined to investigate polymer surfaces, buried interfaces, and multilayer structures across length scales that are difficult to access using conventional XPS depth profiling alone. The capabilities of the Hypulse XPS platform and its potential to provide new insight into the composition and performance of complex polymer products will be discussed.

INTELLIGENT SENSOR ARRAYS FOR CHEMICAL VAPOR DETECTION IN HUMID ENVIRONMENT

Md Delowar Hossain, Brian G. Willis

*Department of Chemical and Biomolecular Engineering,
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Chemical sensor arrays encounter significant challenges when detecting chemical vapors in air due to interference from moisture (humidity). This study combined integrated sensor arrays and artificial intelligence to create distinct chemical fingerprints (“Odor-prints”) and discriminate a wide range of chemical vapors in humid environments. Pico-drop technology was introduced to fabricate integrated multi-chemistry sensor arrays with ten different chemistries, which produced consistent, repeatable and reproducible responses. Thirteen different chemical scents in the range of 0.10 – 0.40 partial pressures were randomly introduced into sensor arrays both in the absence and presence of moisture (at relative humidity of $55 \pm 10\%$ at $22 \pm 2^\circ\text{C}$ temperature). Sensor data was analyzed by machine learning techniques to identify unknown chemicals with high accuracy. In addition to conventional machine learning classification, a new approach based on convolutional neural network models was developed to discriminate chemical vapors based on images of data plots (see below). A 95-97% classification accuracy was achieved both in dry and humid air using both conventional machine learning and image analysis approaches. Excellent results were obtained even when both chemical identity and concentration were unknown. These results are promising for applications of electronic noses to detect chemical vapors in real world applications.

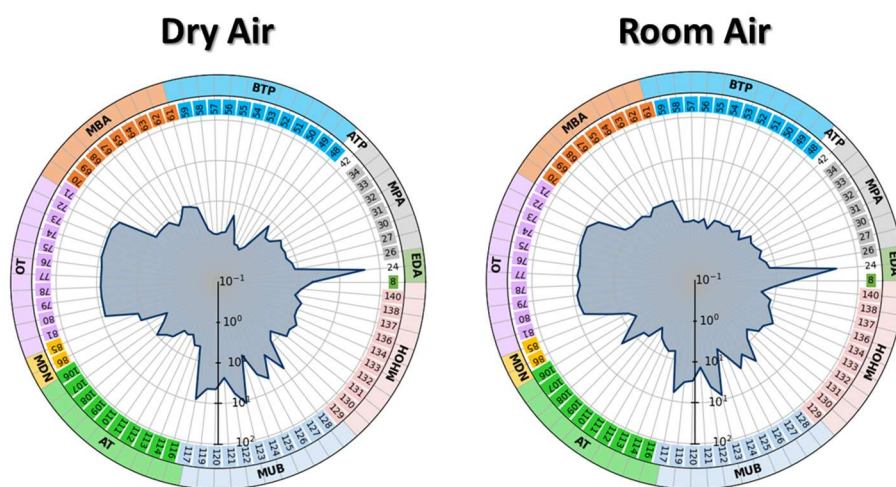


Figure 1: Chemical “Odor-prints” of propanol at 0.10 P/P_{sat} in the absence (left) and presence (right) of moisture. Sensor material and sensor ID are indicated on the perimeter.

Oral Presentation
Graduate Student

SURFACE AND BULK CHARACTERIZATION OF ORGANIC SEMICONDUCTORS USING XPS AND UPS TECHNIQUES

Jonathan Counsell¹, Liam Soomary¹, Chris Moffitt² and David Surman²

(1) Kratos Analytical Ltd. Manchester, UK

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Organic semiconductors have gained significant attention in recently due to their potential for flexible, lightweight, and low-cost electronic applications. These materials, enable charge transport via delocalized electronic states, a characteristic of their π -conjugated molecular structures. Their utility includes various organic electronic devices, including Organic Thin-Film Transistors (OTFTs), Organic Light-Emitting Diodes (OLEDs), Organic Photovoltaics (OPVs), and organic diodes. The selection and performance of these materials depends on the semiconductor properties such as charge carrier mobility, energy level alignment, and stability [1]. Among the widely studied molecules, DNTT and CuPc function as p-type semiconductors, facilitating hole transport, whereas CuF₁₆Pc serves as an n-type semiconductor, supporting electron transport. Additionally, F4TCNQ, a strong electron acceptor, is commonly employed as a molecular dopant to enhance the conductivity of p-type materials. Understanding the surface properties and chemical interactions of these molecules is crucial for optimizing device performance and stability.

We will explain the utility of a combination of experimental methods using a modern X-ray Photoelectron Spectroscopy (XPS) spectrometer (both small-area spectroscopy and 2D XP imaging) to probe the surface and bulk properties of both blanket and printed structures. This approach allows for an in-depth analysis of how organic semiconductors interact with substrates and templating/electrode layers. Additionally, we will explore the effects of deposition processes and the evolution of electrical properties as a function of depth, employing Hard X-ray Photoelectron Spectroscopy (HAXPES) and ion milling techniques. Furthermore, Ultraviolet Photoelectron Spectroscopy (UPS) will be utilized to determine the work function of these materials, a critical parameter in optimizing charge injection and transport. A methodological approach to surface characterization will also be discussed, providing insights into the interfacial properties that govern device performance.

[1] Owen A. Melville, Benoît H. Lessard, and Timothy P. Bender, ACS Applied Materials & Interfaces 2015 7 (24), 13105-13118, DOI: 10.1021/acsami.5b01718

Oral Presentation

MOLECULARLY-INDUCED COLOSSAL THERMAL CONDUCTANCE AND OPTOACOUSTIC DAMPLIFICATION IN INORGANIC/ORGANIC MULTILAYERS

Ankit Kashyap^{1,*}, Jonas Kendra², Collin Rowe¹, Amogh Wasti², Geetu Sharma¹, Karim Bouchmella³, Johan G. Alauzun³, Joseph Kioseoglou⁴, Gaeun Choi⁵, Jinyoung Kim⁵, David G. Cahill⁵, Per Eklund⁶, Theodorian Borca-Tasciuc², Arnaud Devos⁷, and Ganpati Ramanath^{1,6}

¹*Rensselaer Polytechnic Institute, Materials Science and Engineering Department; Troy, NY, USA.*

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⁶*Inorganic Chemistry, Department of Chemistry and Wallenberg Initiative Materials Science for Sustainability (WISE), Ångström Laboratory, Uppsala University, Sweden.*

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Engineering inorganic interfaces with molecular nanolayers (MNLs) is known to yield multifold enhancements in multiple properties (e.g., mechanical, thermal, electrical). Multilayering such interfaces offers possibilities to access emergent responses from superposition of MNL interface effects. Here, we report two unexpected properties in titania/organodiphosphonate-MNL multilayers: frequency-dependent optoacoustic damping and amplification (dampification) and colossal thermal conductance.

Brillouin spectroscopy and optoacoustic modeling show that dampification arises from superposition of MNL-interface-reflected pulse trains. Dampification is sensitive to the number of MNL interfaces and their elastic properties, and is completely contrary to monotonic damping expected at MNL interfaces. Our findings pave way for non-destructively characterizing MNLs at buried interfaces, and designing molecularly-engineered nanomaterials for optoacoustic filtering and rectification.

Using 3w measurements and 2D thermal transport modeling we demonstrate colossal thermal conductance $G_{\text{int}} \gg 1.1 \text{ GWm}^{-2}\text{K}^{-1}$ across MNLs. Such high G_{int} is close to the theoretical limit for inorganic interfaces, and exceeds reported values for interfacial MNLs. Non-equilibrium molecular dynamics computations indicate that aromatic backbone molecules enhance G_{int} more than aliphatic ones. This result positions MNL interface engineering as an option for thermal management in electronics devices and packaging.

Oral presentation
Post Doc

PROSPECTS FOR EBIC MEASUREMENTS FROM LAMELLAE

Greg Johnson¹, Andreas Rummel², Oscar Recalde², Heiko Stegmann¹, Hyunhwa Kim¹,
William Hubbard³, Sven Davani¹

¹ZEISS Microscopy, ²Kleindiek Nanotechnik, ³NanoElectronic Imaging.

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Electron Beam Induced Current (EBIC) is increasingly important for semiconductor defect localization, yield learning, and device characterization. EBIC requires an electron beam, an internal electric field, and a probing system. Electron-hole pairs generated within a p-n junction depletion region are separated by the internal field, producing currents mapped in the EBIC image.

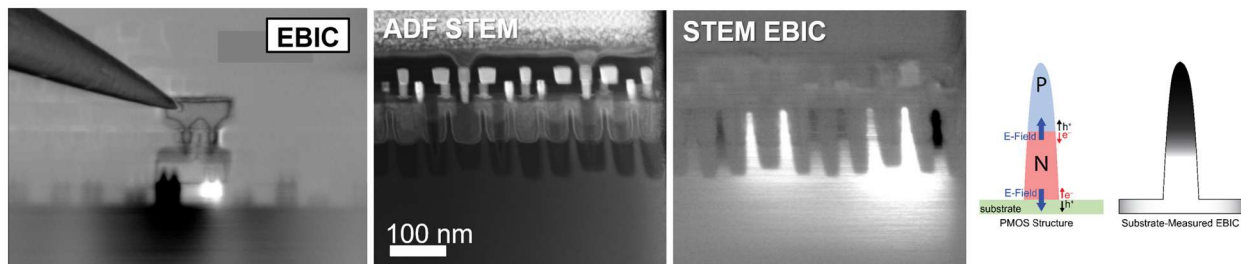
Advanced-node characterization increasingly uses EBIC to examine small junction features, conveniently accessed through gallium focused ion beam (Ga-FIB) lamella preparation, followed by SEM or STEM imaging.

Because Ga^+ acts as a p-type dopant, concerns arise regarding its effects on junction properties. Nonetheless, this work demonstrates high-quality EBIC measurements using two systems, both capable of simultaneously detecting opposite-polarity currents from oppositely oriented electric fields, from Ga-FIB milled samples with no further prep.

1. Kleindiek Nanotechnik PS8 prober shuttle, with EBIC amplifier in a GeminiSEM 300. Nanoprobng needles contact the sample surface, enabling measurements throughout the accessible field of view.
2. NanoElectronic Imaging two-channel STEM-EBIC system, in an FEI Titan 80-300 STEM at 300 keV and ~80 pA. Currents are measured between the top and bottom of a lamella mounted on a TEM grid.

References

- [1] T. E. Everhart et al., Proc. IEEE, 52(12), 1642–1647 (1964).
- [2] G. M. Johnson et al, ISTFA 2024
- [3] W. H. Hubbard et al., “Imaging Dopant Interfaces in 5 nm-Node FinFETs with STEM EBIC,” ISTFA 2026.



Oral presentation

P01. ELECTRON TRANSPORT AND THERMAL STABILITY OF EPITAXIAL Rh/Ir/MgO(001) INTERFACES FOR NANOSCALE INTERCONNECTS

Zahra Ahmadian¹, Oishy Roy¹, Ching-Tzu Chen², Atharv Jog³, Daniel Gall¹

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Rhodium is a promising conductor for nanoscale interconnects due to its low resistivity scaling at small (< 10 nm) dimensions. This study investigates the effects of Rh/Ir interfaces, deposition sequence, and thermal annealing on the electrical transport to evaluate Iridium as a potential liner for Rh metallization. Epitaxial 12-nm-thick Rh(001) and Ir(001) films are sputter-deposited on MgO(001) substrates at 350 °C, cooled to room temperature, and subsequently capped with the opposite metal without breaking vacuum. In situ four-point-probe measurements show that depositing 1 nm of Ir on Rh decreases the sheet resistance by $0.20 \Omega/\square$, as shown in Fig. 1, while depositing 1 nm of Rh on Ir results in a larger reduction by $1.07 \Omega/\square$. Comparison with bare Rh films of equivalent total thickness yields a resistivity penalty of only 6.4% for the 1-nm Ir cap. This behavior is considerably more promising than other metal combinations, where ultrathin metal caps increase the resistance due to enhanced diffuse electron scattering. In addition, both bilayer configurations are subsequently annealed at 450 and 550 °C to investigate if elevated temperatures cause interfacial intermixing and, in turn, a resistivity penalty. Opposite to this expectation, annealing results in a reduction of the sheet resistance, indicating that Rh-Ir intermixing is negligible. These results support the potential use for Ir as a liner or nucleation layer for Rh-based nanoscale interconnects since the resistance penalty in comparison to pure Rh metallization is small and Ir-Rh interfacial intermixing is negligible.

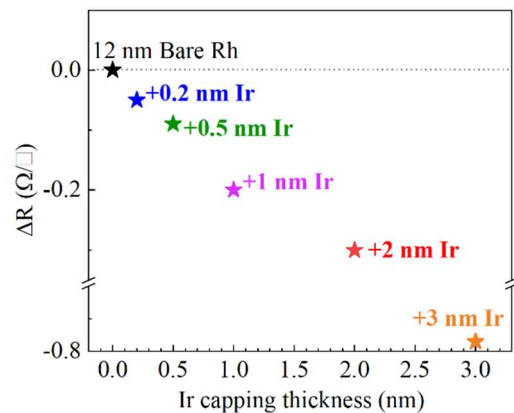


Figure 1: Change in sheet resistance ΔR as a function of Ir cap layer thickness

Poster Presentation
Graduate Student

P02. VIA-SIZE-DEPENDENT MICROSTRUCTURES OF Cu PADS IN CHIPLETS FOR HYBRID BONDING

Weichang Lin^{1,2}, Nicholas Polomoff³, Roy Yu³, Katsuyuki Sakuma³, Zonghuan Lu^{1,2}, Nymul Yeachin^{1,2}, Lihua Zhang⁴, Kim Kisslinger⁴, James Lu^{2,5}, Toh-Ming Lu^{1,2}, Gwo-Ching Wang^{1,2}

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Next-generation 3D-ICs, heterogeneous integration, and advanced packaging require extremely high interconnect density for inter-chip interconnection. Low-temperature, void-free hybrid bonding requires not only atomic-scale wafer smoothness [1], but also a clear understanding of Cu-pad microstructure. Traditional tools, such as transmission electron microscopy (TEM) and electron backscatter diffraction (EBSD), provide local microstructural information. In this work, we demonstrate the first use of glancing-incidence reflection high-energy electron diffraction (RHEED) (Fig. 1a) to probe large areas of hybrid bonding surfaces containing Cu pads above vias. Atomic force microscopy (AFM) reveals that the electroplated Cu pads protrude approximately 4 nm above the surrounding dielectric after chemical-mechanical polishing (CMP) (Fig. 1b). Fig. 1c shows an example RHEED pattern measured at 20 keV (wavelength = 0.08 Å) from the surface of 0.8 mm Cu pads. The ring positions are consistent with near-surface Cu and Cu oxide contributions. RHEED and X-ray diffraction (XRD) measurements across varying Cu pad dimensions further reveal via-size-dependent Cu texture. By probing millimeter-scale areas with the elongated electron beam at a glancing angle, RHEED provides rapid, nondestructive, ensemble-sensitive measurements of the bonding-relevant surfaces and their diffraction signatures prior to hybrid bonding.

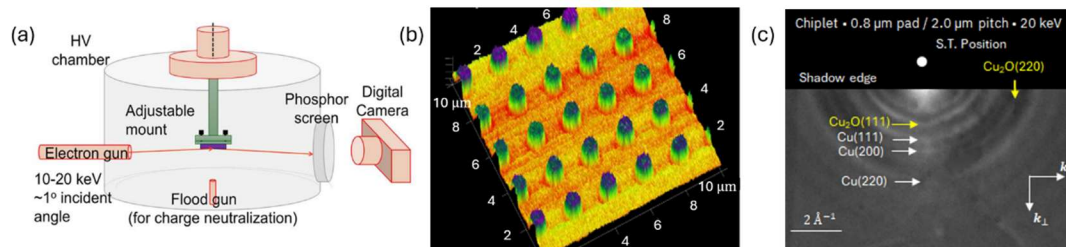


Fig. 1 (a) A schematic of the RHEED setup. (b) AFM topography of protruding Cu pads of 0.8 μm diameter and 2 μm pitch. (c) RHEED pattern at 20 keV from the selected Cu-pad array.

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[1] W. Lin *et al.*, *ECTC*, 829 - 836 (2026), DOI: [10.1109/ECTC51846.2026.00141](https://doi.org/10.1109/ECTC51846.2026.00141).

Poster Presentation
Graduate student

P03. QUANTITATIVE LIGHT-MATTER INTERACTION IN THE THZ RANGE FOR NEAR-FIELD MICROSCOPY

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Scanning Near-Field Optical Microscopy (SNOM) uses a sharp metallic antenna to scan the surface of a sample, providing information about its topography and electric properties. This is achieved by focusing light on the antenna tip, which scatters at varying intensity depending on the electromagnetic interaction between the tip and sample. This allows for deep sub-wavelength resolution, exceeding the limit of conventional microscopes. However, analytical models for tip-sample interaction in SNOM fail to reproduce some experimental results. We use COMSOL Multiphysics, a physical simulation software, to build a more realistic numerical model. We present preliminary data showing the intensity measured when scanning a high-temperature superconductor and compare this to analytical results.

Poster Presentation
Undergraduate Student

P04. THIN FILM GROWTH OF TOPOLOGICAL SEMIMETAL PdGa

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PdGa is a chiral topological semimetal with promise as conductor for next-generation narrow interconnects. Thin films with thickness $d = 200$ nm are deposited on $\text{Al}_2\text{O}_3(1\bar{1}02)$ and $\text{Al}_2\text{O}_3(10\bar{1}0)$ substrates at $T_s = 20$ -800 °C by co-sputtering from Pd and PdGa₂ targets in an ultra-high vacuum magnetron sputtering system. Deposition at $T_s = 20$ °C yields a continuous layer, $T_s = 200$ -300 °C results in 3D growth with irregularly-shaped islands with random crystalline orientations, and $T_s \geq 500$ °C leads to a transition to larger circular islands which exhibit local epitaxy and form a multi-domain microstructure consisting of PdGa grains with both 001 and 102 out-of-plane orientations at $T_s = 800$ °C.

Thinner films with $d = 29$ nm grown at $T_s = 20$ °C have a resistivity $\rho = 91$ $\mu\Omega\cdot\text{cm}$. In situ annealing at $T_a = 100$ and 250 °C for 30 minutes reduces this resistivity to $\rho = 66$ and 54 $\mu\Omega\cdot\text{cm}$, respectively, while $T_a = 400$ °C causes dewetting into separate islands. Capping the as-deposited layer with 0.2 nm of Ta (one monolayer) suppresses dewetting during subsequent annealing and yields dense continuous layers for $T_a \leq 600$ °C, continuous layers with some pinholes for $T_a = 700$ °C, and separate droplet shaped islands for $T_a = 800$ °C. Their resistivity is further reduced to $\rho = 35, 33, 33$, and 32 $\mu\Omega\cdot\text{cm}$ for $T_a = 400, 500, 600$, and 700 °C, respectively. These results demonstrate an effective approach to suppress dewetting of PdGa films using ultrathin Ta caps, providing continuous films for transport measurements.

P05. DEVELOPMENT OF ANALYSIS SYSTEM FOR DETERMINING THE DAMPING RATE, RESONANCE FREQUENCY, AND RESISTANCE OF MEMS DEVICES

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Microelectromechanical systems (MEMS) are micron-scale devices with moving parts. In particular, Menlo Micro produces MEMS-based switches for radio frequency signal propagation. Their MEMS devices have higher switching speeds and lower power consumption than conventional semiconductor-based switches. The MEMS switches use an electrostatically controlled cantilever that is made from a Au-Ni alloy. The electrical contacts of the switch are coated with ruthenium. The MEMS devices are encapsulated in a proprietary gas mixture at a pressure of about 1.5 atm, absolute. Repeated high-velocity impacts from the cantilever's motion can wear down the protective Ru layer over time.

The goal of this project was to design and build a vacuum compatible MEMS test station that could be used to test MEMS devices over a pressure range of 10^{-7} Torr to 2 atm, absolute. A custom ultra-high vacuum (UHV) chamber was built that can be valved off from the main test chamber and backfilled with high purity gasses (Figure 1). The chamber and its flanges are made from SS304 and are sealed with copper gaskets. Electrical signals are sent to and from the MEMS device through UHV electrical feedthroughs. Variable leak valves are used to introduce nitrogen, argon, oxygen, and compressed dry air into the chamber, which allows testing under different gas mixtures at various pressures. A compound pressure gauge is used to monitor of the gas pressure during testing. Measurements of the damping rate and resonance frequency are made under high-vacuum conditions before backfilling the chamber with the various test gasses. Measurements are made at 150 Torr increments up to 750 Torr (~ 1 atm gauge). From these measurements, damping, resonance frequency, and resistivity curves are plotted as a function of pressure.

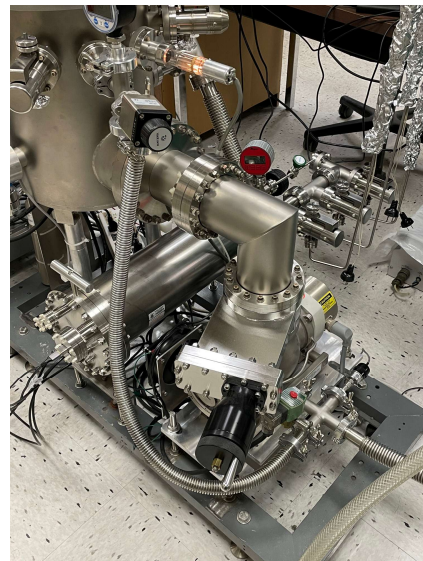


Figure 1: Custom MEMS test chamber.

Poster presentation
Graduate student

P06. MOLECULARLY-INDUCED Co NANOFILM WETTING ON LOW-k SiCOH SURFACES

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Next-generation nanodevice wiring and packing technologies require continuous and uniform <~5-nm-thick metal nanofilms on non-wetting low-k SiCOH surfaces. Here, we use of a sub-nm-thick organosilane molecular nanolayer (MNL) to unobtrusively enable the growth of uniform and continuous Co nanofilms spanning several micrometers. *In vacuo* electron spectroscopy and *ex situ* electron microscopy studies show that organosilane-MNLs can suppress Co islanding and facilitate layer-by-layer Co nanofilm growth. This MNL-induced switch in the growth mode results in significant decrease in Co nanofilm surface roughness measured by atomic force microscopy. The mercaptan-terminated organosilane MNL is more effective than the amine-terminated counterpart, underscoring the importance of Co/MNL interface chemistry. *Ab initio* computations unveil correlations between nanofilm wetting and Co/MNL bonding chemistry in terms of MNL effects on Co surface adatom mobility and dynamics. Our findings collectively suggest that using MNLs is a powerful unobtrusive approach to tailor the inorganic film morphology on a variety of surfaces for applications in nanodevice wiring, packaging, and nanocomposites.

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