2019 ANNUAL SYMPOSIUM

FLORIDA CHAPTER
OF
THE AVS SCIENCE AND TECHNOLOGY SOCIETY

March 11 &12, 2019
University of Central Florida
Engineering Building Atrium
Orlando, Florida

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SYMPOSIUM PROGRAM

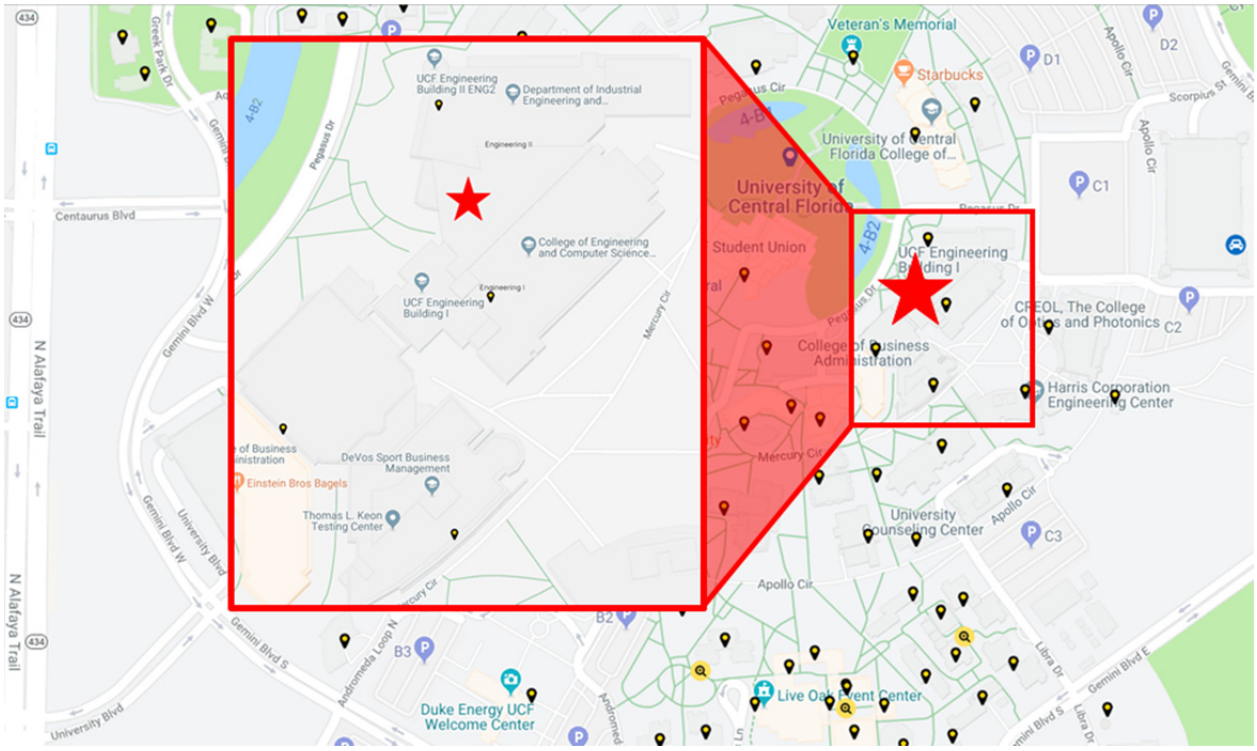
Monday, March 11, 2019

8:30 – 5:00	**Registration**	**Registration Desk**
8:30 – 5:00	**Student Poster Setup**	**Engineering Atrium**
8:30 – 10:30	**Equipment Exhibit Setup**	**Engineering Atrium**
9:15 – 5:45	**Technical Program**	**ENG II Room 102**
5:45 – 8:00	**Poster Session**	**Engineering Atrium**
6:00 – 8:00	**Reception**	**Pegasus Ballroom A-F**

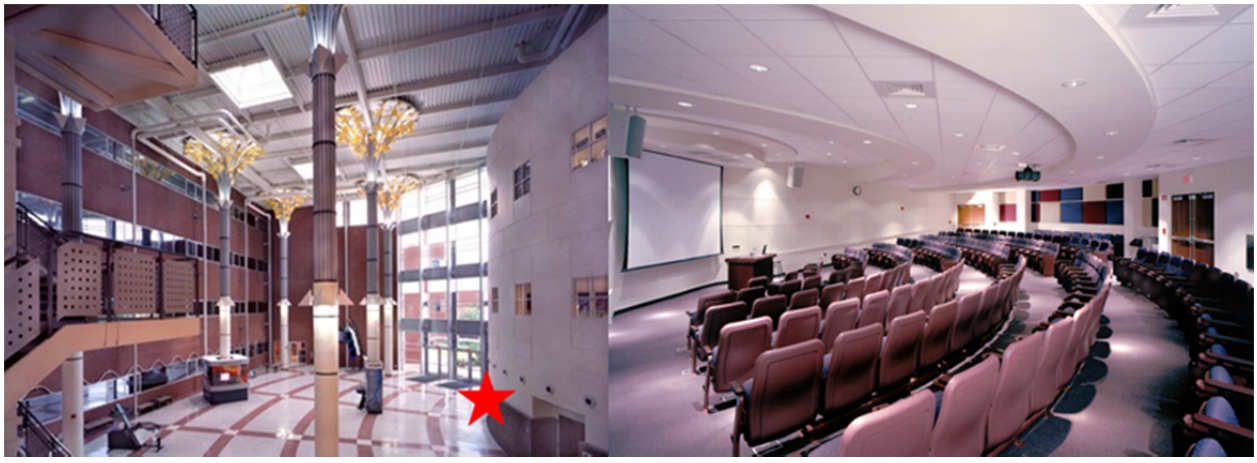
Tuesday, March 12, 2019

9:30 – 5:00	**Technical Program**	**ENG II Room 102**
12:45 – 1:00	**Door Prize Drawing**	**Engineering Atrium**
5:00 – 5:30	**Poster Session Awards**	**Engineering Atrium**
5:30 – 6:30	**Poster Session & Exhibit Breakdown**	**Engineering Atrium**

Meeting Location



12760 Pegasus Drive
Orlando, FL 32816



UCF Engineering Building
Atrium and Adjacent Presentation Room (102)

Parking in Garage D

Monday, March 11, 2019

Opening remarks

9:00-9:15
Engineering II Building, Room 102
Program Chair: Mihai E. Vaida, University of Central Florida

Renewable Energy

9:15-11:00
Chair: Laurene Tetard

9:15-9:45 Invited Speaker - W. David Wei, University of Florida
Surface Plasmon-Driven Water Reduction: Nanoparticle Size Matters

9:45-10:15 Invited Speaker - Kristopher Davis, University of Central Florida
Metal Oxides Thin Films as Passivated, Carrier-Selective Contacts for Photovoltaics

10:15-10:45 Invited Speaker - James M. Fenton, Florida Solar Energy Center
Solar (Photovoltaic Panels) on Your Roof Is Your Best Investment, along with Electric Vehicles, Energy Storage & Energy Efficiency

10:45-11:00 Contributed Talk - Zhengtao Xu, University of Florida
Lead-free Organometallic Halide Double Perovskite: Rubidium Bismuth Iodide Crystal with High Hole Mobility

11:00-11:15 Contributed Talk - Tyler Campbell, University of Central Florida
Water Photo-Oxidation Reaction on Clean and Doped C_2N

11:15-11:30 Coffee Break & Exhibit

Keynote Address

11:30-12:30

Michael G. White
Size-Selected Clusters as Atomically Precise Nanocatalysts
Department of Chemistry, Stony Brook University, Stony Brook, NY, 11794
Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973

12:30-12:40 Group Picture
12:40-1:30 Lunch Break & Exhibit

Electronic Materials and Photonics

1:30-3:30
Chair: Mike Chini

1:30-2:00 Invited Speaker - Prof. Devki Talwar, University of North Florida
Novel GaN_xAs_{1-x} Alloys and Strained GaNAs/GaAs Superlattices: Physics and Applications

2:00-2:30 Invited Speaker - Prof. He Wang, University of Miami
Photophysics of Perovskite Solar Cells

2:30-3:00 Invited Speaker - Dr. Yangyang Liu, University of Central Florida
Time- and Angle-Resolved Photoemission Spectroscopy using an Ultrafast XUV Source at 21.8 eV

3:00-3:15 Contributed Talk - Stefano Barba, University of Florida
Efficient and Cadmium-free quantum dot light emitting diodes based on CuInS2 nanocrystals

3:15-3:30 Contributed Talk – Tao Jiang, University of Central Florida
Absorption and Emission Properties of Defect-Laden Single-Layer Hexagonal Boron Nitride

3:30-3:45 Coffee Break & Exhibit

Thin Films and 2D Materials

3:45-5:45
Chair: Yasuyuki Nakajima & Madhab Neupane

3:45-4:00 Contributed Talk - K A M Hasan Siddiquee, University of Central Florida
De Haas–Van Alphen Effect investigation in topological semimetal candidate $CaSn_3$

4:00-4:30 Invited Speaker - Laurene Tetard, University of Central Florida
Nanoscale functional imaging of 2D materials for nanoelectronics and catalysis

4:30-5:00 Invited Speaker - Amlan Biswas, University of Florida
Controlling Magnetic Anisotropy of Manganites using Electric Fields

5:00-5:30 Invited Speaker - Volodymyr Turkowski, University of Central Florida
Multiparticle interactions and femtosecond charge dynamics in two-dimensional transition-metal dichalcogenides

5:30-5:45 Contributed Talk - Md Mofazzel Hosen, University of Central Florida
Observation of topological nodal-loop state in RAs3 (R = Ca, Sr)

Poster Session and Reception

5:45-8:00 Chair: Laurene Tetard, Mihai Vaida

Tuesday, March 12, 2019

Surface Science and Catalysis

9:30-12:00
Chair: Fudong Liu

9:30-10:00 Invited Speaker - Prof. John Kuhn, University of South Florida
Layered Catalysts for Size Selective Conversion of Hydrocarbons
10:00-10:30 Invited Speaker - Prof. Matthias Batzill, University of South Florida
Introducing Functionalities in van der Waals Materials by Engineering of Lattice Imperfections
10:30-11:00 Invited Speaker - Prof. Helena Hagelin-Weaver, University of Florida
Synthesis of Pt/CeO_2 Catalysts using Atomic Layer Deposition

11:00-11:15 Coffee Break & Exhibit

11:15-11:30 Contributed Talk - Asim Khaniya, University of Central Florida
Epitaxial growth of ultrathin hexagonal Molybdenum Nitride thin film on Ru (0001)
11:30-11:45 Contributed Talk - Naseem Ud Din, University of Central Florida
Redox active Metal Organic Chains for single site catalysis: A first-principles study
11:45-12:00 Contributed Talk - Jiawei Huang, University of Florida
Unraveling the role of atomic structures at Au/TiO_2 interface for O_2 activation

12:00-1:00 Lunch Break & Exhibit

Nanometer-scale Materials, Science, and Technology

1:00-3:00
Chair: Tania Roy

1:00-1:30 Invited Speaker - Yajie Dong, University of Central Florida
Photoluminescent Perovskites and Electroluminescent Quantum Dots
1:30-2:00 Invited Speaker - Jing Guo, University of Florida
Modeling Memristive Devices Based on 2D Materials
2:00-2:30 Invited Speaker - Humberto R. Gutiérrez, University of South Florida
Monolayer and Few-layers Multi-junction Heterostructures by Sequential Edge-epitaxy
2:30-3:00 Invited Speaker - Manh-Huong Phan, University of South Florida
Emergent Ferromagnetism at the single layer limit

3:30-3:15 Coffee Break & Exhibit

Young Leaders Session

3:00-4:00
Chair: William Kaden

3:00-3:20 Dylan J Colvin (Renewable Energy), University of Central Florida
Extracting cell level characteristics from photovoltaic module electroluminescence images

3:20-3:40 Kaiwen Zheng (Electronic and Photonics), University of Florida
Engineering Ultrathin $YBa_2Cu_3O_{7-d}$ to detect single photons

3:40-4:00 Valery Ortiz-Jimenez (Nanometer-scale Materials, Science, and Technology), University of South Florida
A new magnetic sensor using a monolayer magnet

Careers in Vacuum Science and Technology

4:00-5:00
Chair: William Kaden

Kevin Coffey, University of Central Florida - Material Science and Engineering
Fudong Liu, University of Central Florida - Civil, Environmental and Construction Engineering
Kent Brown - Physical Electronics

Poster Session Awards & Symposium Conclusions

Chair: Laurene Tetard, Mihai Vaida

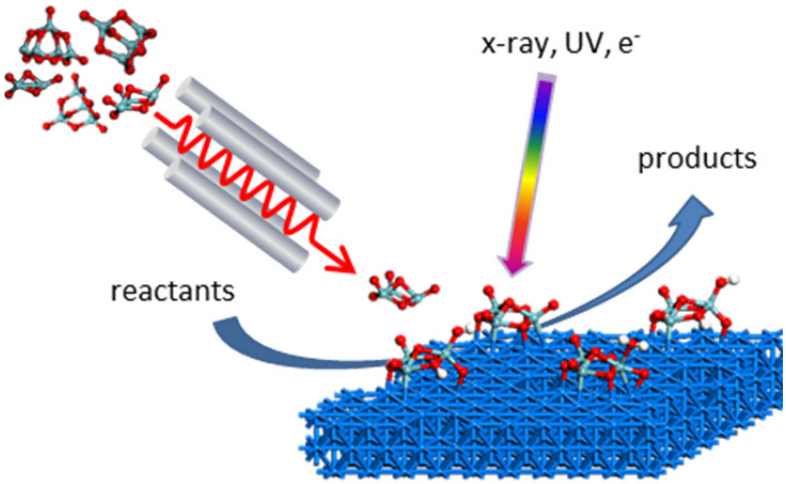
Monday, March 11, 2019

Keynote Address

Size-Selected Clusters as Atomically Precise Nanocatalysts

Michael G. White
Department of Chemistry, Stony Brook University, Stony Brook, NY, 11794
Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973

Sub-nm clusters can exhibit electronic and chemical properties that cannot be anticipated by scaling bulk properties to small sizes. In this non-scalable size regime, nanoclusters composed of 10-50 atoms are closer in behavior to molecular complexes than to crystalline solids and changes of one or few atoms can result in changes in both structure and reactivity. The structures of sub-nm clusters are also sensitive to support interactions and reaction conditions, where strong binding with the support and adsorbates can induce cluster isomerization. This sensitivity to size, composition, and support interactions also provides the opportunity for exploring the catalytic performance of cluster-based materials with atomic-level control. For catalysis applications requiring unprotected clusters, the combination of gas-phase cluster sources and mass spectrometry provides a flexible approach for depositing ultra-small clusters on nearly any support with control over size, atomic composition, and coverage. For metal-compound clusters, e.g., oxides and sulfides, a key advantage of cluster deposition is that it allows control over cluster stoichiometry which provides a means of introducing oxygen/sulfur "vacancies" as well as varying the average cation oxidation state. Moreover, the use of well-ordered supports and size-selected clusters is ideally suited for computational modeling of structure and reactions using density functional electronic structure theory. Results will be presented for size-selected deposition of metal oxide and sulfide clusters on various supports using surface science and ambient-pressure techniques for surface and reactivity characterization.



This work was supported by the U.S Department of Energy, Office of Science, and supported by its Division of Chemical Sciences, Geosciences, and Biosciences within the Office of Basic Energy Sciences under contract No. DE-SC0012704.

Renewable Energy

Chair: Laurene Tetard

9:15-9:45

Surface Plasmon-Driven Water Reduction: Nanoparticle Size Matters

W. David Wei, Ph.D.
Department of Chemistry and Center for Catalysis,
University of Florida, United States, wei@chem.ufl.edu

Plasmonic-metal/semiconductor heterostructures represent promising photocatalytic constructs for solar-to-fuel energy conversion, but detailed knowledge of the structure-function relationships governing their activity remains elusive. Here, we monitor plasmon-mediated electron transfer (PMET) across Au-TiO_2 Schottky junctions at the single-nanoparticle level to clarify the role of metal nanocrystal size in plasmonic photochemistry. Size-dependent photovoltage studies of PMET in Au/TiO_2 photoelectrodes reveal that the reduction potential of hot electrons within the TiO_2 conduction band is not solely determined by the absolute size of Au nanoparticles, but by the relative size of Au to TiO_2. With this new insight, we tailored the physical dimensions of Au/TiO_2 photocatalysts to efficiently harvest hot electrons for improved plasmon-driven hydrogen evolution from water. Taken together, these studies elucidate the role of metal nanocrystal size in plasmonic photocatalysis and establish general guidelines for the rational design of plasmonic-metal/semiconductor assemblies that can effectively exploit hot carriers in photochemical reactions.

9:45-10:15

Metal Oxides Thin Films as Passivated, Carrier-Selective Contacts for Photovoltaics

Kristopher O. Davis
Materials Science and Engineering
University of Central Florida, Orlando, Florida

In recent years, photovoltaic (PV) systems have emerged as a cost-competitive alternative to traditional energy sources like coal and nuclear power. Within the PV sector, crystalline silicon (c-Si) PV cells and modules dominate the market with approximately 95% market share as of 2017. c-Si PV is a platform for innovation with new materials (e.g., passivation layers, optical coatings, contact materials) being explored by industry and academia. Contact passivation is an emerging area where new materials have the potential to drastically improve the performance of c-Si PV cells. Metal-silicon interfaces have a high concentration of interface states leading to significant carrier recombination at any silicon surface touching the metal contacts. In this presentation, metal oxide heterostructures and thin passivating interlayers are used to limit carrier recombination due to metal contacts without compromising the series resistance. The amorphous metal oxides used in this work can act as electron-selective (e.g., titanium oxide) or hole-selective (e.g., molybdenum oxide) contacts, depending on their work function and bandgap. Investigations into the process-structure-property relationships of these films has provided insight that is now being used to improve the performance and stability of these materials. This work is supported by the U.S. Department of Energy SunShot Initiative, under Award Number DE-EE0007533.

10:15-10:45

Solar (*Photovoltaic Panels*) on Your Roof Is Your Best Investment, along with Electric Vehicles, Energy Storage & Energy Efficiency

Dr. James Fenton
Florida Solar Energy Center and University of Central Florida

Today, in Florida the installed cost of PV on your roof can be as low as $2.00 per peak Watt. At this price, the levelized cost of electricity from your roof is almost one-third the cost from the utility (about 4¢ per kWh from your roof versus about 11.8¢ per kWh from the utility). New and Retrofitted Net-Zero Energy Homes with additional PV for Electric Vehicle use are more than cost effective today. There are over 20 models of electric vehicles that are so efficient that the solar system on your roof produces electricity at the gasoline equivalent of $0.27 a gallon. As prices for solar and EVs continue to decrease, and as range anxiety is eliminated through 200-mile range EVs, consumer adoption rates for both technologies will increase dramatically, resulting in an integration of solar energy, energy efficient buildings and electric transportation infrastructure. Will we get out in front and surf the wave created by the solar and EV tsunami or will we drown?

10:45-11:00

LEAD-FREE ORGANOMETALLIC HALIDE DOUBLE PEROVSKITE: RUBIDIUM BISMUTH IODIDE CRYSTAL WITH HIGH HOLE MOBILITY

Zhengtao Xu[1], Michael Sexton[1], Stephen Xie[1], Richard Hennig[1], Simon Phillpot[1], and Jiangeng Xue[1]
[1] Department of Materials Science and Engineering, University of Florida, Gainesville, Florida 32611, United States

Organometallic halide perovskites (OHPs) have become a primary focus of optoelectronic research due to their desired properties of high absorption coefficients, high carrier mobilities, and surprising defect tolerance with the ability to be synthesized from solution. Unfortunately, the highest performing OHP methylammonium lead iodide ($MAPbI_3$) is unstable in high moisture environments and contains a toxic heavy metal lead. Different from traditional perovskite structure, AbX_3, we are exploring new elemental and molecular components of double perovskite structures with two valence sharing metal cations that do not contain toxic elements with an $A_2BB'X_6$ formula. 75 attempted double perovskite structures were experimentally investigated based on modified form of Goldschmidt tolerance factor and the search lead to the discovery of a new quaternary organometallic compound of rubidium, bismuth, and iodide. Single crystal of this compound was obtained using a low cost and moderate temperature solution-based crystal growth method. Single crystal X-ray diffraction indicates an I4 (#79) space group symmetry. An Impressive hole mobility and an optical bandgap within the visible range make the compound optimal for single junction photovoltaic devices, although there remain challenges in synthesizing high quality thin films to take advantage of low energy solution-based device fabrication method.

11:00-11:15

Water Photo-Oxidation Reaction on Clean and Doped C_2N

Tyler Campbell, Dr. Sergey Stolbov
University of Central Florida, 4000 Central Florida Blvd, Orlando, FL 32816

In the search for new efficient photo-catalysts for hydrogen production through water splitting, the main attention has been paid to tuning the band gap width and its position with respect to vacuum level. However, actual electro-catalytic activity for the water oxidation reaction on a catalyst surface is no less important than those quantities. In this work we evaluate from first principles the thermodynamics of the reaction on relatively new candidates for water splitting: two-dimensional C_2N and that doped with phosphorus. We find that the 4-step reaction usually expected for water splitting will not proceed on these systems, resulting in oxygen atoms left strongly adsorbed to the surface. Another option, a 3-step reaction, is also found to be unfavorable. We also test an effect of higher oxygen coverage on the reaction thermodynamics, as suggested elsewhere. We find that indeed the doubled O-coverage makes the 4-step reaction feasible for the doped C_2N. However, an unacceptably high anode potential is required to make this reaction to proceed. We thus conclude that the materials under consideration may not be efficient electro-catalysts for water splitting.

Electronic Materials and Photonics

Chair: Mike Chini

1:30-2:00

Novel GaN_xAs_{1-x} Alloys and Strained GaNAs/GaAs Superlattices: Physics and Applications

Devki N. Talwar
Department of Physics, University of North Florida, Jacksonville, 32224, USA

The group III-nitride (GaN, AlN, InN) based wide band-gap semiconductors have attracted much attention in recent years due to progress in the development of blue/UV light emitting diodes (LEDs), laser diodes (LDs) and high temperature/high power electronic devices. Cubic gallium nitride (c-GaN) has many advantages over the hexagonal material (h-GaN) including higher carrier mobility and ease of doping. Although, c-GaN has been successfully grown using molecular beam epitaxy (MBE) on GaAs substrates, the growth of heteroepitaxial III-N-V alloys and superlattice structures (SLs) is still a challenge. The ternary and quaternary alloys of c-GaN and III-V compound semiconductors (e.g., GaN_xAs_{1-x} and Ga_{1-x} $In_xAs_{1-y}N_y$, etc.) have attracted special interest because of their unique properties and wide range of applications in optoelectronics viz., vertical-cavity surface emitting lasers (VCSELs), fiber-optic communications, and high efficiency hybrid solar cells. Efforts have been made recently to grow GaN_xAs_{1-x}/GaAs with nitrogen compositions of $x < 0.05$ by using metalorganic molecular beam epitaxy (MOMBE) and metalorganic vapor phase epitaxy (MOVPE), respectively. The device performance based on these novel alloys is, however, limited by the low nitrogen concentration achievable. Determining the nitrogen contents in the epilayers grown on GaAs has been and still is an issue. Infrared absorption, ellipsometry, and Raman scattering techniques are powerful tools for studying the optical properties of thin films and SLs. The spectral dependence of dielectric function can reveal important material properties *viz.,* band-to-band transition (fundamental band-gap E_o), complex index of refraction, infrared-active modes or the absorption due to free-carrier effects. In this work we report the results of our comprehensive study on the structural, electronic and optical properties of GaN_xAs_{1-x} alloys and strained GaN_xAs_{1-x}/GaAs SLs as a function of composition, layer thickness and strain. The influence of N on the electronic and vibrational properties of GaN_xAs_{1-x} alloys and GaN_xAs_{1-x}/GaAs SLs observed by infrared, photoluminescence, and Raman spectroscopy is analyzed theoretically. The correlation between the strength of N-related local vibrational mode (LVM) and its frequency as a function of x (x_{LVM}) in GaN_xAs_{1-x} alloys is used to estimate the N contents. The nitrogen content by x-ray diffraction (x_{XRD}) is also obtained indirectly from the separation of GaAs substrate and the GaN_xAs_{1-x} layer peak. An empirical fit to x_{LVM} as a function of x_{XRD} for $x < 0.03$ provided a reliable calibration for determining N composition not only in the ternary alloys but also in the quaternary Ga_{1-x} $In_xAs_{1-y}N_y$ materials.

2:00-2:30

Photophysics of Perovskite Solar Cells

He Wang
University of Miami

The organic-inorganic hybrid perovskite solar cell has achieved efficiency on par with that of commercial silicon solar cell. The major challenge of bringing perovskite solar cells towards commercialization is their inherent instability especially with regards to moisture. The introduction of hydrophobic cation of large size into a 3D perovskite structure which typically aids in the formation of quasi-2D perovskite structure is a promising method for maintaining high efficiency while introducing a high stability toward moisture. I will first describe how we manipulate the phase purity and vertical distribution for quasi-2D perovskite structure proven by ultrafast transient absorption spectroscopy. Furthermore, the incorporation of a small amount of hydrophobic cation into the perovskite layer aids in the improvement of solar cell performance and stability. To understand such enhancement, we use transient absorption and reflection spectroscopy to compare the carrier dynamics in the bulk and at the surface. Our findings suggest that large cations preferentially accumulate at the film surface. The crystal preferential orientation, crystallinity, grain sizes all increase with the incorporation of large cation.

2:30-3:00

Time- and Angle-Resolved Photoemission Spectroscopy using an Ultrafast XUV Source at 21.8 eV

Yangyang Liu[1], John Beetar[1], Md Mofazzel Hosen[1], Gyanendra Dhakal[1], Christopher Sims[1], Marc Etienne[1], Firoza Kabir[1], Klauss Dimitri[1], Sabin Regmi[1], Madhab Neupane[1], and Michael Chini[1,2]
[1]Department of Physics, University of Central Florida, Orlando, FL 32816, USA
[2]CREOL, The College of Optics and Photonics, University of Central Florida, Orlando FL 32816

Time- and angle-resolved photoemission spectroscopy (trARPES) is a powerful tool for studying quantum materials, since it can not only measure non-equilibrium states, but also track carrier dynamics on femtosecond to picosecond timescales. Here, we demonstrate an innovative time- and angle-resolved photoemission spectroscopy apparatus utilizing high-order harmonic probe pulses generated by a robust, high power Yb: KGW amplifier with a tunable repetition rate from 50 to 200 kHz. Driving high-order harmonics by the second harmonic of the fundamental Yb pulses enables us to isolate the 9th harmonic (21.8 eV) probe pulses easily without using the monochromator. The on-target flux of the 9^{th} harmonic can reach around 5×10^{10} photons per second. The overall time and energy resolutions are measured to be 380 fs and 40 meV, respectively. Here we will present the characterization of the XUV source and the time-resolved measurements on topological materials.

3:00-3F15

Efficient and Cadmium-free quantum dot light emitting diodes based on CuInS2 nanocrystals

Stefano Barba, Zhengtao Xu, Alexandra Knowles, Yanli Liu, and Jiangeng Xue
Dept. of Materials Science and Engineering,
University of Florida, Gainesville, Florida 32611, USA

While significant advances in the development of quantum dot light emitting diodes (QLEDs) have been reported, these devices are primarily based on cadmium chalcogenide quantum dot (QD) materials. Both environmental and health concerns arise due to the toxicity of cadmium and consequently, alternative less toxic QDs must be developed for large scale QLED applications such as display and solid-state lighting technologies. In this work, copper indium disulfide (CIS) was investigated as an alternative material for QLED applications. We report on several approaches to synthesize core CIS QDs and show the injection of 1-octanethiol as sulfur precursor resulted in highly luminescent QDs. Core-shell structures were then synthesized using an extend shell reaction method in which shell thickness was varied through increasing reaction time. Using synthesized core-shell QDs as the emissive layer in multilayer devices, single color QLEDs were fabricated with peak emissions from 590-600nm resulting in an orange-yellow color. Results showed that shell thickness plays a significant role in device performance, with the thicker shell QLEDs displaying a maximum current efficiency of 14.7 cd/A and external quantum efficiency of 5.2% while exhibiting a low operating voltage of 1.8V.

3:15-3:30

Absorption and Emission Properties of Defect-Laden Single-Layer Hexagonal Boron Nitride

Tao Jiang, Volodymyr Turkowski and Talat S. Rahman
Department of Physics, University of Central Florida, Orlando, FL 32816

We perform the density functional theory (DFT) and time-dependent DFT (TDDFT) analysis of the optical properties of monolayers of pure (*h*-BN) and defect-laden hexagonal Boron Nitride *dh*-BN with different types of point defects - boron vacancy (V_B), nitrogen vacancy (V_N), boron substitution for nitrogen (B_N), nitrogen substitution for boron (N_B), carbon substitution for boron (C_B) and carbon substitution for nitrogen (C_N). Our DFT analysis traces the defect-induced changes to the orbital- and spin-projected density of states of *h*-BN and how these changes modify the optical properties of the system. The TDDFT results demonstrate that experimental data on the emission in *dh*-BN [1] can be explained by charge transitions between states induced by the V_N defect. Namely, the dominant contribution to the photoluminescence spectrum of the system arises from transitions between orbitals on boron atoms next to the vacancy. We also demonstrate that in order to reproduce the experimental data the TDDFT exchange-correlation kernel should be of a long-range type, i.e. it should have the Coulomb singularity. We discuss possible applications of the results in optoelectronic single-photon emitting devices. Work is supported in part by DOE grant DE-FG02-07ER46354.

[1] T.T. Tran et al., Nature Nanotech. 11, 37 (2016).

Thin Films and 2D Materials

Chairs: Yasuyuki Nakajima & Madhab Neupane

3:45-4:00

De Haas–Van Alphen effect investigation in topological semimetal candidate $CaSn_3$

K A M Hasan Siddiquee[1], Riffat Munir[1], Charuni Dissanayake[1], Xinzhe Hu[2], Swapnil Yadav[2], Yasumasa Takano[2], Eun Sang Choi[3], Duy Le[1], Yasuyuki Nakajima[1]

[1]University of Central Florida, Dept. of Physics, 4111 Libra Drive, Orlando, FL 32816,
[2]University of Florida, Dept. of Physic, 2001 Museum Rd, Gainesville, FL 32611,
[3]National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL 32310

Theoretically predicted, binary stannide $CaSn_3$ is one of the promising candidates of topological semimetals (TSMs). It undergoes superconductivity at Tc ≈ 4.2K which provides an excellent platform for understanding the interplay between topological physics and superconductivity. To understand this interplay, a detailed study of the electronic structure is needed. Here, we present a de Haas – van Alphen (dHvA) oscillations study for $CaSn_3$ single crystals via torque magnetometry in high magnetic fields up to 35T. Analyzing the dependence of dHvA oscillation frequency and amplitude on temperatures and field angles, we will review the effective carrier masses and the fermi surfaces, and also discuss the non-trivial Berry phase in $CaSn_3$.

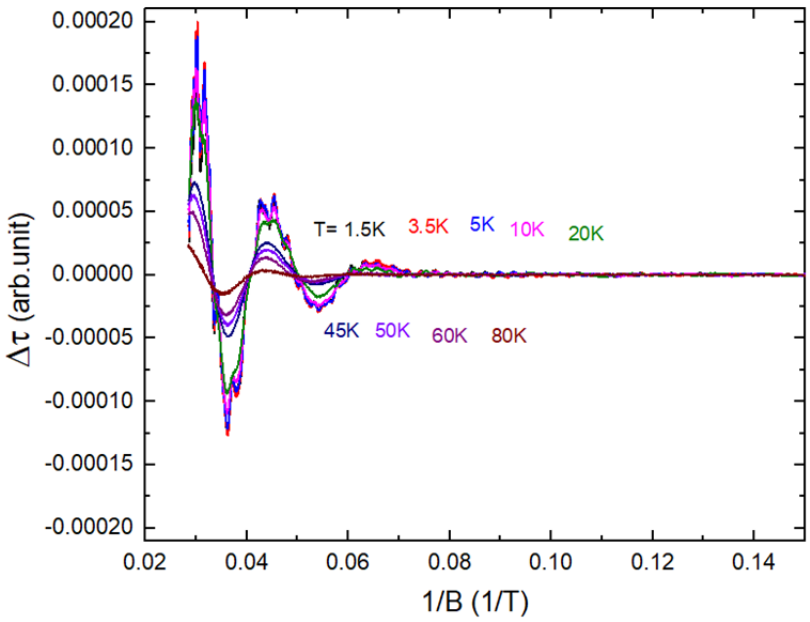


Fig.1: dHvA oscillation data in $CaSn_3$ at different temperatures.

4:00-4:30

Nanoscale functional imaging of 2D materials for nanoelectronics and catalysis

Fernand Torres-Davila[a,c], Yi Ding[a,c] and, Laurene Tetard[a,b,c]
[a]Physics Department, [b]Materials Science and Engineering Department, [c]NanoScience Technology Center, University of Central Florida, Orlando, FL, 32816

The functional exploration of defects in 2D materials is motivated by the important changes in electronic and catalytic properties they introduce. Doping and defect engineering are commonly used to tweak the performance of active materials in nanoelectronics, energy harvesting, energy storage or catalysis. However, conventional spectroscopy schemes fail to resolve the local changes resulting from such alterations in the lattice of the atomically thin layers. Until recently, the paucity of experimental tools capable of probing materials properties beyond morphology with nanometer scale resolution has hindered advances in this understanding. This limitation can now be surpassed by exploiting the functional modes of atomic force microscopy, including force spectroscopy and nanoscale infrared spectroscopy.

In this presentation, we will discuss several means of controllably introducing local changes and defects in 2D materials. We will show how the defects created affect the structural, mechanical and electrical properties of the system. In turn, we will present some evidence that the defects can become interesting sites for targeted chemical reactions. The study constitutes a new approach to understanding changes in local electronic and catalytic properties. The results provide some insight on the mechanisms of catalysis at the nanoscale, with implications for large scale 2D material production for nanoelectronics and for chemical reactions. In closing, we will provide a perspective on the required steps for nanoscale characterization to further impact applications of 2D materials.

4:30-5:00

Controlling Magnetic Anisotropy of Manganites using Electric Fields

Amlan Biswas
Department of Physics, University of Florida

The prototypical ferromagnetic manganite $La_{1-x}Sr_xMnO_3$ (LSMO) and its interfaces with substrates have garnered significant attention since LSMO is a half-metallic ferromagnet with a strong potential for device applications. Controlling the magnetic anisotropy of LSMO is a specific area of interest and recent studies have shown that in addition to interface engineering, nanometer scale patterning can also be used to modify the magnetic anisotropy parameters. However, the transition to ferromagnetism below the Curie temperature (T_C) in LSMO is of the second order and the main parameters which can be tweaked are magnetocrystalline anisotropy (MCA) and exchange interactions. If ferromagnetism was achieved through a first order transition, nucleation and growth of the ferromagnetic regions introduces an additional handle on magnetic anisotropy *viz.* shape anisotropy. As opposed to the interatomic scale, quantum effect such as MCA, shape anisotropy is a classical effect which is manifested due to magnetostatic interactions at larger length scales and these two mechanisms for magnetic anisotropy could be in competition with each other. The electronically phase separated manganite $(La_{1-y}Pr_y)_{1-x}Ca_xMnO_3$ (LPCMO) shows a first order transition from a high temperature charge ordered insulator (COI) to a low temperature ferromagnetic metal (FMM) and is an excellent material to

study the combined effects of MCA and shape anisotropy. We have fabricated micro structures of LPCMO using photolithography to apply both uniform and non-uniform electric fields across the sample. Our results show that an electric field can realign the fluid-like FMM regions embedded in a COI background, a phenomenon similar to dielectrophoresis of metallic particles suspended in fluid media. I will show how this effect can be used to control the magnetic anisotropy of manganites using an electric field.

5:00-5:30

Multiparticle interactions and femtosecond charge dynamics in two-dimensional transition-metal dichalcogenides

Volodymyr Turkowski
Department of Physics, University of Central Florida, Orlando, FL 32816-2385, USA

Two-dimensional transition metal dichalcogenide (TMD) materials demonstrate variety of fascinating properties: strongly-pronounced absorption and emission of light, different tightly-bound electron-hole states and unusual femtosecond charge dynamics. These properties are very interesting from the points of view of both fundamental science and practical applications. We give a summary of the most important of these properties and of details of our density-matrix time-dependent density-functional theory approach capable to study such types of problems at the ab initio level of accuracy. We proceed with our results for the excitation spectrum of TMDs, with emphasis on the exciton, trion and biexciton states, that are in a good agreement with experimental data. Next, we present our results for the emission spectrum and ultrafast charge dynamics in several TMDs, including details of the inter-layer charge migration, role of phonons in the ultrafast charge response, possible Bose-Einstein condensation and other multi-exciton effects in presence of strong magnetic field. At the end, we summarize current understanding of the physical properties of two-dimensional TMDs and list the most important remaining open questions in the field.

Work supported in part by DOE Grant No. DOE-DE-FG02-07ER46354.

5:30-5:45

Observation of topological nodal-loop state in RAs_3 (R = Ca, Sr)

Md Mofazzel Hosen[1], Gyanendra Dhakal[1], Baokai Wang[2], Klauss Dimitri[1], Firoza Kabir[1], Christopher Sims[1], Sabin Regmi[1], Tomasz Durakiewicz[3], Dariusz Kaczorowski[4], Arun Bansil[2], and Madhab Neupane[1]
[1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA
[2]Department of Physics, Northeastern University, Boston, Massachusetts 02115, USA
[3]Institute of Physics, Maria Curie - Sklodowska University, 20-031 Lublin, Poland
[4]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50-950 Wroclaw, Poland

The topological nodal line/loop semimetal is a unique class of material with a one-dimensional line node connected by the surface states known as drumhead surface state. However, a direct observation of such drumhead surface state in a clean system are still elusive. Here, using high-resolution angle-resolved photoemission spectroscopy (ARPES) along with first-principles calculations, we report the observation of a topological nodal-loop (TNL) in $SrAs_3$ whereas

$CaAs_3$ exhibit topologically trivial state. Our analysis reveals that surface projections of the bulk nodal-points are connected by drumhead surface states in $SrAs_3$. Importantly, the observed topological states in RAs_3 (R = Ca,Sr) are well separated from other unwanted metallic bands near the Fermi level. RAs_3, thus, offers a unique opportunity to realize an archetype nodal-loop semimetal and establish a platform for gaining a deeper understanding of the nodal physics.

Tuesday, March 12, 2019

Surface Science and Catalysis

Chair: Fudong Liu

9:30-10:00

Layered Catalysts for Size Selective Conversion of Hydrocarbons

John N. Kuhn
University of South Florida, Tampa, USA

Layered catalysts are defined as multicomponent catalysts that possess important structural features resolved spatially at various length scales. The presentation will describe approaches in heterogeneous catalyst employing layered catalysts as well as demonstrate recently developed advances in coating a conventional core with a zeolite shell to achieve size selectivity. At USF, we coat zeolite shells around reforming catalyst cores to achieve size selective steam reforming of various size hydrocarbons (i.e., methane and toluene). The role of layer thickness and shell acidity are reviewed and augmented by spectroscopic adsorption of pyridine as a probe molecule. The results demonstrate that methane reforming also occurs more readily due to regulation of transport rates through the shell despite toluene reforming being thermodynamically favored. Thus, this study provides a key step toward enabling layered catalysts for intensified methane conversion processes.

10:00-10:30

Introducing Functionalities in van der Waals Materials by Engineering of Lattice Imperfections

Matthias Batzill
Department of Physics, University of South Florida, Tampa, FL 33620, USA

Edges, defects, and dopants in 2D transition metal dichalcogenides have been shown to give rise to chemical, electronic, and magnetic properties in these materials. To utilize the potential of these modifications a detailed understanding of their controlled formation and atomic scale properties is needed. In our group we aim at synthesizing 2D materials by molecular beam epitaxy and study approaches for controlled modifications by alloying, doping, one-dimensional modifications (edges or grain boundaries) or interfacing with dissimilar materials. In this talk we present our studies on the controlled formation of metallic mirror twin grain boundaries in $MoSe_2$ [1] or $MoTe_2$ [2] by incorporation of excess Mo into the lattice. Very high density of MTB networks can be obtained in $MoTe_2$ that effectively metallizes the material and thus may act as a metallic contact patch [3]. Such line defects may also increase electrocatalytic properties for hydrogen evolution reactions [4]. On a more fundamental level, we show that these 1D metallic grain boundaries host one dimensional electron gas and we present the first angle

resolved photoemission (ARPES) studies of such line defects. These studies show evidence for the presence of Tomonaga-Luttinger Liquid behavior of 1D electron systems [5]. Finally, we show that other transition metals may also be incorporated into $MoTe_2$ and the incorporation of vanadium induces room temperature ferromagnetic ordering and thus is an example of a 2D dilute ferromagnetic semiconductor.

[1] Y Ma, S Kolekar, H Coy Diaz, J Aprojanz, I Miccoli, C Tegenkamp, M Batzill. Metallic Twin Grain Boundaries Embedded in $MoSe_2$ Monolayers Grown by Molecular Beam Epitaxy. *ACS Nano* 11, 5130-5139 (2017)
[2] HC Diaz, Y Ma, R Chaghi, M Batzill. High density of (pseudo) periodic twin-grain boundaries in molecular beam epitaxy-grown van der Waals heterostructure: $MoTe_2/MoS_2$. *Appl. Phys. Lett.* 108, 191606 (2016)
[3] PM Coelho, HP Komsa, H Coy Diaz, Y Ma, AV Krasheninnikov, M Batzill. Post-Synthesis Modifications of Two-Dimensional $MoSe_2$ or $MoTe_2$ by Incorporation of Excess Metal Atoms into the Crystal Structure. *ACS Nano* 12, 3975-3984 (2018).
[4] T Kosmala, H Coy Diaz, HP Komsa, Y Ma, AV Krasheninnikov, M Batzill, S Agnoli. Metallic Twin Boundaries Boost the Hydrogen Evolution Reaction on the Basal Plane of Molybdenum Selenotellurides. Adv. Energy Mat., 1800031 (2018).
[5] Y Ma, et al. Angle resolved photoemission spectroscopy reveals spin charge separation in metallic $MoSe_2$ grain boundary. *Nature Commun.* 8, 14231 (2017).

10:30-11:00

Synthesis of Pt/CeO_2 Catalysts using Atomic Layer Deposition

Bochuan Song and Helena E. Hagelin Weaver
Chemical Engineering, University of Florida, Gainesville, FL 32611

Using Atomic Layer Deposition (ALD) to synthesize heterogeneous catalysts with atomic level precision has gained increasing interest in recent years. In our laboratory we have synthesized well-defined heterogeneous catalysts by depositing Pt onto various CeO_2 nanoshapes using ALD. The benefit of using CeO_2 nanoshapes is that the surface facets of each shape are well defined, as the CeO_2 octahedra have (111) surface terminations, the CeO_2 cubes expose (100) surface facets, while the CeO_2 rods consist of (100) and (110) surface facets. Therefore, this allows us to determine the influence of the support oxide surface structure on the active metal and ultimately on the probe reactions. These catalysts can also facilitate identifying structure-activity relationships, as well as comparisons to theoretical studies and ultra-high vacuum surface science studies on single crystals. By using ALD during catalyst synthesis we obtain better control over the active metal deposition, compared with conventional catalyst preparation techniques. We have shown that by tuning the ALD conditions, such as precursor temperature, deposition temperature and dose length, we can carefully control the Pt loading on the CeO_2 nanoshapes. The Pt loading and the CeO_2 surface facet have significant effects on the CO oxidation, which we have used as our initial probe reaction.

11:15-11:30

Epitaxial growth of ultrathin hexagonal Molybdenum Nitride thin film on Ru (0001)

Asim Khaniya[1], Dr. William Kaden[1,2]
[1]Department of Physics, University of Central Florida, Orlando, FL 32816
[2]Energy Conversion and Propulsion Cluster, University of Central Florida, Orlando, FL 32816

The growth and characterization of ultrathin molybdenum nitride on Ru (0001) is studied by means of X-ray photo emission spectroscopy (XPS), Low energy electron diffraction (LEED), and Ion- scattering spectroscopy (ISS). Nitride films were prepared by Molybdenum (Mo) vapor deposition and subsequent annealing to 600 K. The substrate was exposed to N^+ immediately before and after Mo evaporation. The thickness of films in this study, ranging from 0.4 nm to 1.2 nm, were calculated from the attenuation of XPS intensity of Ru substrate. ISS results demonstrate that Ru (0001) substrate is completely covered by nitride overlayer of thickness ~ 0.6 nm. For quantitative analysis of molybdenum nitride films, we used XPS to determine the concentration of Mo and N atoms present on the films and estimated to be one to one stoichiometry of MoN. The chemical state information of Mo 3d in together with stoichiometry and observed sharp 1x1 hexagonal LEED pattern confirms the epitaxial growth of hexagonal molybdenum nitride thin films on Ru (001). As the nitride films were stable in the temperature range of (600-700) K, it started to decompose beyond 700 K and the film were completely free from nitrogen at 1100 K.

11:30-11:45

Redox active Metal Organic Chains for single site catalysis:
A first-principles study

Naseem Ud Din, Duy Le, Talat Rahman,
Department of Physics, University of Central Florida, Orlando, FL 32826

A periodic network with uniform single metal active site, in coordination with redox-active ligands, is a promising class of materials for next generation single atom catalysts. Towards this quest and inspired by recent findings[1], we have carried out first-principles density functional theory (DFT) based calculations of the geometrical and electronic structure and magnetic properties of several transition-metal-organic-chains (TM-C). Of particular interest are Bis-pyrimidinyl-tetrazine (BMTZ) and Bis-pyrimidine (BP) ligands used to design the TM-C with the single Fe or V atom as the coordination center. Our results suggest that TM-BMTZ form a planar chain structure while TM-BP lead to a non-planar arrangement. Bader charge analyses show that while the TM atom is oxidized in both formations, the effect of BMTZ is more reducing than that of BP. Spin polarized DFT calculations show that Fe-BP forms a ferromagnetic (FM) ground state while V-BP results in an anti-ferromagnetic (AFM) ground state. On the other hand, both Fe-BMTZ and V-BMTZ yield AFM ground state. Moreover, adsorption of atomic oxygen on the metal site distorts the planarity of TM-C and draws on average a charge of 0.65e ±0.05 from the metal center. Both Fe and V lose 0.24e and 0.4e respectively while forming the O-TM-BP complex, and 0.21e and 0.39e while forming O-TM-BMTZ complex. We discuss the implications of our findings on ongoing experiments.

1. C. D. Tempas, D. Skomski, B. J. Cook, D. Le, K. A. Smith, T. S. Rahman, K. G. Caulton, and S. L. Tait, Chem. Eur. J. 10.1002/chem.201802943 (2018).

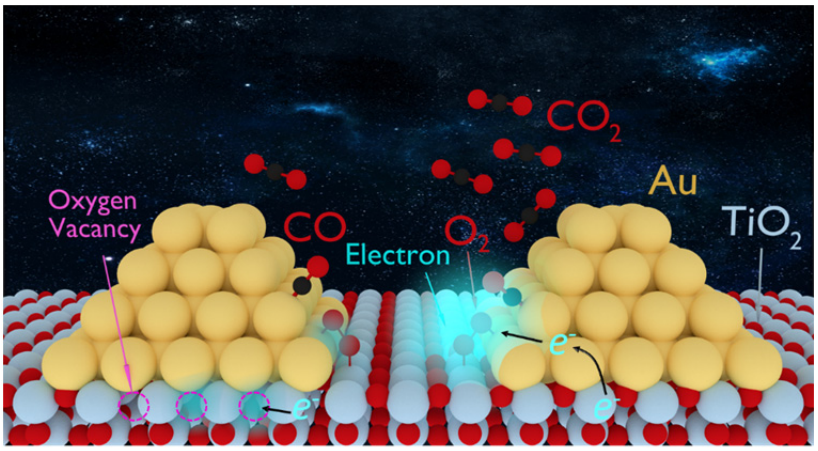
11:45-12:00

Unraveling the role of Atomic Structures at Au/TiO_2 Interface for O_2 Activation

Jiawei Huang[1], Shuai He[1], Justin L. Goodsell[1], Justin R. Mulcahy[1], Alexander Angerhofer[1], and Wei David Wei[1*]

[1]Department of Chemistry and Center for Catalysis, University of Florida, Gainesville, Florida 32611, United States

Metal/oxide interface has been extensively studied due to its importance for heterogeneous catalysis, however, to date, the exact role of interfacial atomic structures in governing catalytic processes still remains elusive. Herein, we demonstrate how the manipulation of atomic structures at the Au/TiO_2 interface significantly alters the interfacial electron distribution and prompts O_2 activation. It is discovered that at the defect-free Au/TiO_2 interface, electrons transfer from Ti centers into Au nanoparticles (NPs) and further migrate from Au into adsorbed perimeter O_2 molecules (i.e., in the form of Au-O-O-Ti), facilitating O_2 activation and leading to a 34 times higher CO oxidation activity than that on the oxygen vacancy (V_o)-rich interface, at which electrons from Ti centers are trapped by interfacial V_o on TiO_2 and hardly interact with perimeter O_2 molecules. Collectively, our results establish an atomic-level description of the underlying mechanism regulating the atomic structure at the interface of metal/oxide heterostructures for optimizing heterogeneous catalysis.



Nanometer-scale Materials, Science, and Technology

Chair: Tania Roy

1:00-1:30

Photoluminescent Perovskites and Electroluminescent Quantum Dots

Yajie Dong, Ph. D., Assistant Professor of University of Central Florida

I will report our recent developments on photoluminescent perovskite materials and electroluminescent quantum dot devices. A versatile swelling-deswelling microencapsulation strategy has been developed to achieve well dispersed, intimately passivated, green emitting perovskite nanoparticles inside polymer film matrixes with high photoluminescence efficiency, color purity and ultrahigh stability against heat and water exposure. These outstanding green perovskite-polymer composite films could work with other red state-of-the art downconverters (i.e. QDs or narrow band phosphors) and enable low cost, efficient, color-vivid, and cadmium free back light unites (BLUs) for liquid crystal displays (LCDs). We have developed ultra-bright and efficient deep red quantum dot light emitting devices (QLEDs). While actively working on extending QLED lifetime to meet demanding requirements of display industry, we are also exploring emerging photomedical light source markets. I will report recent developments of flexible QLED light sources which promise to enable the widespread clinical acceptance of photomedical strategies for cancer treatments, wound repair or aesthetics.

1:30-2:00

Modeling Memristive Devices Based on 2D Materials

Jing Guo
Department of ECE, University of Florida

Memristive devices based on 2D materials have attracted strong research interests for potential applications in efficient hardware implementation of machine learning algorithms. The modeling, simulation, and design issues of the memristors based on 2D materials are discussed in this talk. We show that the unique properties of the 2D materials offer the potential to achieve extremely low power and unprecedented tunability for memristive devices. The scaling behaviors of the memristive devices based on 2D materials are also examined.

[1] Z. Dong, H. Zhao, D. DiMarzio, M. Han, L. Zhang, J. Tice, H. Wang and J. Guo, "Atomically Thin CBRAM Enabled by 2D Materials: Scaling Behaviors and Performance Limits," *IEEE Trans. on Electron Devices*, May, 2018, **DOI:** 10.1109/TED.2018.2830328
[2] H. Zhao, Z. Dong, H. Tian. D. DiMarzi, M. Han, L. Zhang, X. Yan, F. Liu, L. Shen, S. Han, S. Cronin, W. Wu, J. Tice, J. Guo, H. Wang, "Atomically-thin Femtojoule Memristive Device," *Advanced Materials*, 29, 1703232, 2017.

2:00:2:30

Monolayer and Few-layers Multi-junction Heterostructures by Sequential Edge-epitaxy

Humberto R. Gutiérrez
Physics Department, University of South Florida

Atomically thin layers are known as two-dimensional (2D) materials and have attracted a growing attention due to their great potential as building blocks for a future generation of low-power and

flexible 2D optoelectronic devices. Similar to the well-established 3D electronics, the development of functional 2D devices will depend on our ability to fabricate heterostructures and junctions where the optical and electronic properties of different compounds are brought together to create new functionalities. Vertical heterostructures can be produced by selective van der Waals stacking of different monolayers with distinct chemical composition. However, in-plane lateral heterostructures, where different materials are combined within a single 2D layer, have proven to be more challenging. During the formation of the hetero-junction, it is important to minimize the incorporation of undesired impurities and the formation of crystal defects at the junction that will impact the functionality of the 2D device. When fabricating periodic structures, it is equally important to develop the ability to control the domain size of each material. In this talk, we will review different techniques that have been used to create 2D lateral heterostructures of transition metal dichalcogenide compounds. Emphasis will be made in our recently reported one-pot synthesis approach, using a single heterogeneous solid source, for the continuous fabrication of lateral multi-junction heterostructures of TMD monolayers. In this method, the heterojunctions are sequentially created by only changing the composition of the reactive gas environment in the presence of water vapor. This allows to selectively control the water-induced oxidation and volatilization of each transition metal precursors, as well as its nucleation on the substrate, leading to sequential edge-epitaxy of distinct TMDs. This simple method has proven to be effective for continuous growth of TMD-based multi-junction lateral heterostructures, including selenides, sulfides and ternary alloys. Basic devices with field effect transistor configuration were fabricated to studythe electrical behavior of these heterojunctions, their diode-like response, photo-response as a function of laser power as well as photovoltaic behavior of the heterojunctions will be discussed.

2:30-3:00

Emergent Ferromagnetism at the single layer limit

Manh-Huong Phan
Department of Physics, University of South Florida, USA

Two-dimensional (2D) magnetic van der Waals materials are emerging candidates for ultralow-power and ultra-compact device applications. Although the Mermin-Wagner theorem predicts suppression of long-range magnetic order at finite temperatures in such 2D materials, recent experiments have demonstrated the existence of intrinsic long-range ferromagnetic ordering in bulk van der Waals materials at the single layer limit [1-3]. In particular, our discovery of the strong room temperature ferromagnetism in epitaxially grown transition metal dichalcogenide (TMD) monolayers of VSe_2 has the potential to transform the field of van der Waals spintronics [3]. In this talk, I will present research progress in 2D magnetism, including our new findings of tunable exchange bias effect and light-controlled magnetism in monolayers of VSe_2 grown on MoS_2 substrates, as well as the design of a new class of highly sensitive magnetic sensor using this single layer magnet.

[1] C. Gong et al., *Nature* 546, 265 (2017) ; [2] B. Huang et al., *Nature* 546, 270 (2017) ; [3] M. Bonilla et al., *Nature Nanotechnology* 13, 289 (2018)

Young Leaders Session

Chair: William Kaden

3:00-3:20

Extracting cell level characteristics from photovoltaic module electroluminescence images

Dylan J. Colvin[1], Eric J. Schneller[1], Kristopher O. Davis[1]

[1] Department of Material Science and Engineering, University of Central Florida, 32816

Electroluminescence (EL) images are typically taken to examine photovoltaic (PV) modules. This work presents a method of extracting cell level characteristics from module level images. EL images are typically examined individually for cracks, locations of hotspots, cell darkening, etc. However, this work presents a method of taking multiple images (a "sweep" of images) at different bias conditions. This allows us to map the operating voltage of each cell in a module and extract dark *I-V* characteristics. The extracted data is then analyzed to calculate device characteristics, such as series resistance, ideality factors, and saturation current densities. The parameters can then be converted into an image, such as Fig. 1. This method is currently being applied to studying module degradation at the cell level.

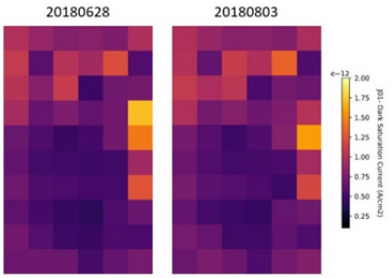


Fig. 1. Dark saturation current density (J_{01}) parameter images of the same module after one month of dark storage.

Some challenges have arisen regarding extracting accurate results. The *I-V* data extracted from the EL images have been compared against dark *I-V* measured directly via Kelvin sensing (Fig. 2). There is strong consistency between measurements (e.g., Fig. 1), but factors such as exposure time and injection level impact measurement accuracy. We are currently in the process of mitigating the impact of these factors and will present our findings.

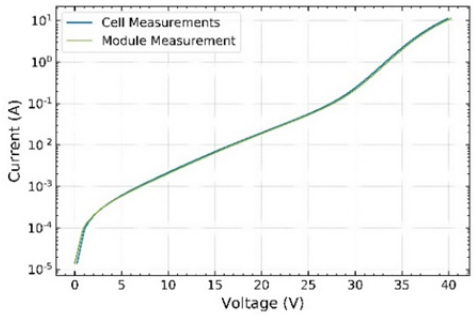


Fig. 2. Cells were measured using the four-point probe method, while the module data were extracted by clamping the leads onto the ribbons in the junction box.

3:20-3:40

Engineering Ultrathin $YBa_2Cu_3O_{7-d}$ to detect single photons

Kaiwen Zheng[1], Reza Baghdadi[2], Karl Berggren[2], Cameron Kopas[3], Nathan Newman[3]
[1]University of Florida, 32607,[2]Massachusetts Institute of Technology, 02139, [3]Arizona State University, 85287

Being able to detect single photon is essential to quantum information processing and quantum communication. Superconducting nanowire single photon detector (SNSPD) is one of the most promising ways of detecting single photon and has been realized using NbN. Compared to NbN, $YBa_2Cu_3O_{7-d}$ allows for denser packing of detectors and higher operating temperature because of its small coherence length and higher critical temperature. However, to detect individual photons of interest the device has to have a thickness of 4 – 10 nm, which is extremely challenging considering that the size of $YBa_2Cu_3O_{7-d}$ unit cell is ~1.2 nm. In this poster, we will present our approach to optimizing the superconducting properties of $YBa_2Cu_3O_{7-d}$ to meet the standard of single photon detection by adjusting the type of substrate, the temperature of the heater, and the partial pressure of O_2.

3:40-4:00

A new magnetic sensor using a monolayer magnet

Valery Ortiz-Jimenez[1], Vijaysankar Kalappattil[1], Tatiana Eggers[1], Manuel Bonilla[1], Sadhu Kholekar[1], Pham Thanh Huy[2], Matthias Batzill[1], and Manh-Huong Phan[1]
[1]Department of Physics, University of South Florida, Tampa, FL 33620, USA
[2]Phenikaa Institute for Advanced Study, Phenikaa University, Yen Nghia, Ha-Dong District, Hanoi 1000, Vietnam

Ferromagnetic monolayer films are emerging as promising candidate materials for applications in ultra-compact spintronic nanodevices, nanosensors, and information storage. Our recent discovery of the strong room temperature ferromagnetism in monolayer films of VSe_2 grown on graphite or MoS_2 substrate has opened new opportunities to explore these single layer magnets for such applications. A new type of sensor is proposed consisting of an LC circuit composed of soft ferromagnetic microwire utilizing a single layer VSe_2 film as a highly sensitive magnetic core. The sensor relies in changes in resonance frequency caused by varying applied DC magnetic fields. The field modifies the DC permeability of the sensor causing shifts of the resonance frequency in the order of MHz upon small applied fields. The sensitivity of the sensor reaches an extremely high value of 16×10^6 Hz/Oe, making it an excellent candidate for a wide range of magnetic sensing applications at room temperature.

Poster Session

P-1 HEAVY METAL FREE QUANTUM DOTS - A ROBUST DELIVERY VEHICLE FOR ANTIBIOTICS FOR ENHANCED ANTIBACTERIAL ACTIVITY, Tyler Maxwell[1,2], Parthiban Rajasekaran[2], Mikaeel Young[2,3], Morgan Schaff[2], and Swadeshmukul Santra[1,2,3,4], [1]Department of Chemistry, [2]NanoScience Technology Center, [3]Burnett School of Biomedical Sciences, [4]Department of Materials Science and Engineering, University of Central Florida, Orlando, FL, 32816

P-2 CARBOXYL MODIFIED ZnO NANOPARTICLES FOR DELIVERY OF STREPTOMYCIN ANTIBIOTIC, Priscila Louis[1], Ali Ozcan[1,2], Nirav Modha[2], Swadeshmukul Santra[1,2,3,4], [1]Department of Chemistry, [2]NanoScience Technology Center,[3]Burnett School of Biomedical Sciences, [4]Department of Materials Science and Engineering, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL 32816

P-3 LOCALLY SYSTEMIC PESTICIDE (LSP) PARTICLES FOR BACTERIAL SPOT DISEASE MANAGEMENT OF TOMATO, Ali Ozcan[1,2], Mikaeel Young[1,3], Mitsushita Doomra[1,3], Swadeshmukul Santra[1,2,3,4], [1]NanoScience Technology Center, [2]Department of Chemistry, [3] Burnett School of Biomedical Sciences, [4]Department of Materials Science and Engineering, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL 32816

P-4 EVALUATING COPPER UPTAKE THROUGH NANOTECHNOLOGY-ASSISTED DELIVERY TO COMBAT BACTERIAL SPOT DISEASE IN TOMATO PLANTS, Ahmad Khater[1,2], Briana Lee[1], Ali Ozcan[1,2], Mikhael Soliman[1,3], Swadeshmukul Santra[1,2,3], Laurene Tetard[1,3,4], [1]NanoScience Technology Center, 12424 Research Parkway, Suite 400, Orlando, FL, 32826 USA, [2]Department of Chemistry, University of Central Florida, Orlando, FL, 32816 USA, [3]Department of Materials Science and Engineering, University of Central Florida, Orlando, FL, 32816 USA, [4]Department of Physics, University of Central Florida, Orlando, FL, 32816 USA

P-5 NOVEL COATING TO ENHANCE PHYSICAL PROPERTIES OF A GLASS-CERAMIC VENEER, Hsu SM[1], Ren F[2], Chen Z[2], Kim MJ[1], Beers K[2], Clark AE[1], Neal D[3], Fares C[2], Esquivel-Upshaw JF[1], [1]University of Florida College of Dentistry, Department of Restorative Dental Sciences, 1395 Center Drive, Gainesville, FL, 32610, [2]University of Florida College of Engineering, Department of Chemical Engineering, 1030 Center Drive, Gainesville, FL 32611, [3]University of Florida College of Medicine, Department of Surgery, 1600 SW Archer Rd M509 Gainesville, FL, 32610

P- 6 A MINIMALLY-INVASIVE 3D-PRINTED MICRONEEDLE ARRAY APPLICATOR SYSTEM (μNAAS) FOR DELIVERY OF THERAPEUTICS TO CITRUS LEAF TISSUE, Laboni Santra[1, 2], Avra Kundu[2], Swaminathan Rajaraman[2,3,4,5*], [1]Oviedo High School, 601 King St, Oviedo, FL 32765, [2]NanoScience Technology Center (NSTC), UCF, 4353 Scorpius Street, Orlando, FL 32816, [3]Department of Material Science and Engineering, UCF, Orlando, FL 32816, [4]Department of Electrical & Computer Engineering, UCF, Orlando, FL 32816, [5]Burnett School of Biomedical Sciences, UCF, 4110 Libra Dr. Orlando, FL 32816-2364

P-7 ANTIMICROBIAL MODE OF ACTIVITY OF ULTRA-SMALL SIZE ZnO NANOPARTICLE, Mitsushita Doomra[γ,μ], Ali Ozcan[μ,λ], Tyler Maxwell[μ,λ], Zon Thwin[μ,λ], Mikaeel Young[γ,μ], Maria Campos [μ,λ], and Swadeshmukul Santra[γ, μ, λ, £,*,γ] Burnett School of Biomedical Sciences, [μ]NanoScience Technology Center, [λ]Department of Chemistry and [£]Department of Materials Science and Engineering, University of Central Florida, 4353 Scorpius Street, Orlando, FL 32816, USA.

P-8 NANO-ZINC COATED UREA FERTILIZER FOR EFFICIENT DELIVERY OF ZINC MICRONUTRIENT, Maria Campos[1], Christian Dimkpa[2], Swadeshmukul Santra[1,3], [1]NanoScience Technology Center, 4353 Scorpius St, Suite 243 – University of Central Florida, Orlando, FL 32816, [2]International Fertilizer Development Center, P.O. Box 2040 - Muscle Shoals, AL 35662, [3]Department of Chemistry, Department of Materials Science and Engineering and Burnett School of Biomedical Sciences, 4353 Scorpius St, Suite 245 – University of Central Florida, Orlando, FL 32816

P-9 N-ACETYLCYSTEINE AND BETAINE COATED IRON OXIDE MAGNETIC NANOPARTICLES IN BIOMEDICAL APPLICATION, Danya Belnour[1], Maria Campos[2], **Swadeshmukul Santra[3]**, [1]College of Medicine, [2]NanoScience Technology Center, [3]Department of Chemistry, University of Central Florida

P-10 SEMICONDUCTOR CAREER READINESS ORGANIZATION, Andrew Thomas, Gregory Koller, Brent Gila, University of Florida, 1041 Center Drive, Gainesville FL 32611

P-11 REALIZATION OF ARTIFICIAL NEURONS AND SYNAPSES USING 2D MoS_2, Adithi Krishnaprasad[1], Durjoy Dev[1], Tania Roy[1,2], [1]Nanoscience Technology Center, University of Central Florida, Orlando FL 32826, USA, [2] Department of Materials Science and Engineering, University of Central Florida, Orlando FL 32816, USA.

P-12 SYNTHESIS OF VERTICAL MoO_2/MoS_2 CORE-SHELL STRUCTURES USING MoO_3 THIN FILM AS A PRECURSOR VIA CHEMICAL VAPOR DEPOSITION, Vanessa Charles, Bhim Chamlagain, Saiful Khondaker, NanoScience Technology Center, University of Central Florida

P-13 TUNING OF TRANSPORT PROPERTY OF MoS_2 FIELD-EFFECT TRANSISTOR BY ASSEMBLING 2D-0D STRUCTURE, Bhim Chamlagain and Saiful Khondaker, NanoScience Technology Center, University of Central Florida, Orlando, FL 32826

P-14 THE MECHANISM OF ACETYLENE FORMATION ON 2D-MoS_2 DECORATED WITH Mo NANOPARTICLES, Brett Young[1], Md Afjal Khan Pathan[2], Cody Jordon[2], Trong Nguyen[2], Nikki Marrow[2], Denisia M. Popolan-Vaida[1], and Mihai E. Vaida[2,3], [1]Department of Chemistry, University of Central Florida, Orlando, Florida 32816, United States, [2]Department of Physics, University of Central Florida, Orlando, Florida 32816, United States, [3]Energy Conversion and Propulsion Cluster, University of Central Florida, Orlando, Florida 32816, United States

P-15 CENTIMETER-SCALE PERIODICALLY CORRUGATED FEW LAYER 2D MoS_2 WITH TENSILE STRETCH-DRIVEN TUNABLE MULTIFUNCTIONALITIES, Emmanuel Okogbue[1,2], Jung Han Kim[2], Tae-Jun Ko[2], Hee-Suk Chung[3], Adithi Krishnaprasad[1], Jean Calderon Flores[1,4], Shraddha Nehate[2], Md Golam Kaium[1], Jong Bae Park[3], Sei-Jin Lee[3], Kalpathy B. Sundaram[2], Lei Zhai[1,4,5], Tania Roy[1,2,5] and Yeonwoong Jung*[1,2,5], [1]Nanoscience Technology Center, University of Central Florida, Orlando, Florida 32826, USA. [2]Department of Electrical and Computer Engineering, University of Central Florida, Orlando, Florida 32826, USA, [3]Analytical Research Division, Korea Basic Science Institute, Jeonju 54907, South Korea, [4]Department of Chemistry, University of Central Florida, Orlando, Florida 32826, USA, [5]Department of Materials Science and Engineering, University of Central Florida, Orlando, Florida 32826, USA.

P-16 METALLIZATION OF THE Si(001) SURFACE: MOLECULAR DYNAMICS SIMULATIONS USING A NEURAL NETWORK POTENTIAL, Sonali Joshi[1], Duy Le[1], Talat S. Rahman[1], [1]Department of Physics, University of Central Florida, 4000 Central Florida Blvd. Orlando, Florida, 32816

P-17 CHARACTERISTICS OF A SINGLE MOLECULE MAGNET (MN_3 DIMER) ON GRAPHENE, Rainier S. Berkley, Zahra Hooshmand, Duy Le, Talat S. Rahman, Department of Physics, University of Central Florida, Orlando, Florida, USA

P-18 EFFECTS OF PLASMA TREATMENT AND ANNEALING ON PECVD DEPOSITED SIC FILMS, Chaker Fares[1], Jessica Partain[1], Randy Elhassani[1], Zhiting Chen[1], Fan Ren[1], ShuMin Hsu[2], Mijin Kim[2], Josephine F. Esquivel-Upshaw[2], [1] University of Florida College of Engineering, Department of Chemical Engineering, Gainesville, FL, [2] University of Florida College of Dentistry, Department of Restorative Dental Sciences, Division of Prosthodontics Gainesville, FL

P- 19 ELECTRIC-FIELD MITIGATION TECHNIQUES FOR IMPROVING Ga_2O_3 RECTIFIER PERFORMANCE, Patrick Carey[1], Jiancheng Yang[1], Fan Ren[1], and Stephen J. Pearton[2], [1]Department of Chemical Engineering, University of Florida, Gainesville, Florida 32611, USA, [2] Department of Materials Science and Engineering, University of Florida, Gainesville, Florida 32611, USA

P-20 EFFECTS OF Se COMPOSITION IN $CdSe_XTe_{1-X}$/CdTe SOLAR CELLS, Sheikh Tawsif Elahi, Chris Ferekides, Department of Electrical Engineering, University of South Florida, 4202 East Fowler Ave., Tampa, FL 33620

P-21 THE IMPACT OF COPPER DOPING ON THE PERFORMANCE OF CDTE SOLAR CELL, Md Zahangir Alom, Chris Ferekides, Department of Electrical Engineering, University of South Florida, 4202 East Fowler Ave, Tampa Florida, 33620

P-22 MESOPOROUS SILICA SUPPORTED PEROVSKITE OXIDE FOR LOW TEMPERATURE THERMOCHEMICAL CO_2 CONVERSION, Jeremy Brower[1], Venkat Bhethanabotla, Ph.D.[1], John Kuhn, Ph.D., [1]Department of Chemical & Biomedical Engineering, University of South Florida, 4202 E Fowler Ave, Tampa, Florida, 33620

P-23 MAGNETOCALORIC MICROWIRE ARRAYS FOR ENERGY-EFFICIENT MAGNETIC REFRIGERATION, Chang-Ming Hung, Hariharan Srikanth, and Manh-Huong Phan, Department of Physics, University of South Florida, Tampa, Florida 33620, USA

P-24 COMPUTATIONAL STUDY OF THE ADSORPTION OF BI-METALLIC CLUSTERS, Nusaiba Zaman, Karima Lasri and Abdelkader Kara, Department of Physics, University of Central Florida, Orlando FL-32816

P-25 MOLYBDENUM NITRIDE THIN-FILM DEVELOPMENT AND SCREENING FOR HYDRODENITROGENATION CATALYSIS, Muhammad Sajid, Asim Khaniya, William Kaden and Abdelkader Kara, Department of Physics, University of Central Florida

P-26 EXPERIMENTAL STUDY OF METHANE FRAGMENTATION AND RECOMBINATION FROM LOW ENERGY ELECTRON INTERACTIONS, Brian C. Ferrari[1], Nestor F. Aguirre[2], Christopher J. Bennett[1,3,4,5], [1]Department of Physics, University of Central Florida, 4111 Libra Drive, Orlando FL 32816, [2]Los Alamos National Laboratory, Los Alamos, NM 87545, [3]Department of Chemistry, University of Central Florida, 4111 Libra Drive, Orlando FL 32816, [4]Florida Space Institute, 12354 Research Parkway, Partnership 1 Building, Suite 214, Orlando FL 32826, [5]Department of Chemistry & Biochemistry, Georgia Institute of Technology, 901 Atlantic Drive, Atlanta, GA 30332

P-27 CO_2 CAPURING, ACTIVATION, AND SPLITTING ON TWO DIMENSIONAL TANTALUM DISULFIDE, Cody Jordan[1], Md Afjal K. Pathan[1], and Mihai E. Vaida[1,2], Department of Physics, University of Central Florida, Orlando, Florida, 32816, United States, Energy Conversion and Propulsion Cluster, University of Central Florida, Orlando, Florida, 32816, United States

P-28 OBSERVATION OF NODAL LOOPS IN HFP2, Christopher Sims[1], M. Mofazzel Hosen[1], Hugo Aramberri[2], Gyanendra Dhakal[1], Klauss Dimitri[1], Firoza Kabir[1], Sabin Regmi[1], Cheng-Yi Huang[4], Xiaoting Zhou[4], Tay-Rong Chang[4], Tomasz Durakiewicz[5], Hsin Lin[3], Dariusz Kaczorowski[6], Nicholas Kioussis[2], and Madhab Neupane[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA, [2]Department of Physics and Astronomy, California State University, Northridge, California 91330, USA, [3]Institute of Physics, Academia Sinica, Taipei 11529, Taiwan, [4]Department of Physics, National Cheng Kung University, Taipei, 701, Taiwan, [5]Institute of Physics, Maria Curie - Sklodowska University, 20-031 Lublin, Poland [6]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50-950 Wroclaw, Poland

P-29 QUANTUM SPIN LIQUID STATE IN THREE DIMENSIONAL METAL-ORGANIC FRAMEWORKS, Charuni Dissanayake[1], KAM Siddiquee[1], Riffat Munir[1], Wesley Newsome[2], Fernando Uribe-Romo[2], Xinzhe Hu[3], Swapnil Yadav[3], Yasumasa Takano[3], Eun Sang

Choi[4], Yasuyuki Nakajima[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, [2]Department of Chemistry, University of Central Florida, Orlando, Florida 32816 [3]Department of Physics, University of Florida, Gainesville, Florida 32611, [4]National High Magnetic Field Laboratory, Florida State University, Tallahassee, Florida 32310

P-30 ELECTRICAL SPICE SIMULATION OF NANOMETER-THICK FERROELECTRIC HAFNIUM FILMS, P. Chojecki and T. Nishida, Department of Electrical and Computer Engineering, University of Florida, Gainesville, Florida, 32611, USA

P-31 OBSERVATION OF MULTIPLE DIRAC STATES IN $EuMg_2Bi_2$, Firoza Kabir[1], M. Mofazzel Hosen[1], Fairoja Cheenicode -Kabeer[2], Alex Aperis[2], Gyanendra Dhakal[1], Klauss Dimitri[1], Christopher Sims[1], Sabin Regmi[1], Tomasz Durakiewicz[3], Peter M. Oppeneer[2], Dariusz Kaczorowski[4], and Madhab Neupane[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA, [2]Department of Physics and Astronomy, Uppsala University, P. O. Box 516, S-75120 Uppsala, Sweden, [3]Condensed Matter and Magnet Science Group, Los Alamos National Laboratory, Los Alamos, NM 87545, USA, [4]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50-950 Wroclaw, Poland

P-32 OBSERVATION OF DIRAC-LIKE SURFACE STATE IN ANTIFERROMAGNETIC DySb, Klauss Dimitri[1], M. Mofazzel Hosen[1], Gyanendra Dhakal[1], Eric D. Bauer[2], Firoza Kabir[1], Filip Ronning[2], and Madhab Neupane[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA, [2]Condensed Matter and Magnet Science Group, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

P-33 OBSERVATION OF SURFACE DIRAC DISPERSION IN TRANSITION METAL DIPNICTIDES, Gyanendra Dhakal[1], M. Mofazzel Hosen[1] , Wei-Chi Chu[2], Bahadur Singh[2], Klauss Dimitri[1], BaoKai Wang[2], Firoza Kabir[1], Christopher Sims[1], Sabin Regmi[1], Tomasz Durakiewicz[3], Dariusz Kaczorowski[4], Arun Bansil[2], and Madhab Neupane[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA, [2]Department of Physics, Northeastern University, Boston, Massachusetts 02115, USA, [3]Institute of Physics, Maria Curie - Sklodowska University, 20-031 Lublin, Poland, [4]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50-950 Wroclaw, Poland

P-34 THIN FILM FERROELECTRIC HAFNIUM OXIDE FOR MEMORY AND LOGIC APPLICATIONS, Glen Walters*, Toshikazu Nishida*, Department of Electrical and Computer Engineering, University of Florida, Gainesville, Florida, 32611, USA

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Poudel[3], Klauss Dimitri[1], Firoza Kabir[1], Christopher Sims[1], Sabin Regmi[1], Tomasz Durakiewicz[4], Krzysztof Gofryk[3], Dariusz Kaczorowski[5], Arun Bansil[2], and Madhab Neupane[1], [1]Department of Physics, University of Central Florida, Orlando, Florida 32816, USA, [2]Department of Physics, Northeastern University, Boston, Massachusetts 02115, USA, [3]Idaho National Laboratory, Idaho Falls, Idaho 83415, USA, [4]Institute of Physics, Maria Curie - Sklodowska University, 20-031 Lublin, Poland, [5]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50- 950 Wroclaw, Poland

P-37 ENGINEERED PATH TOWARDS SUPERCONDUCTIVITY THROUGH MAGNETIC EXCHANGE IN TRANSITION-METAL INTERCALATED BILAYER GRAPHENE, Aditi Mahabir[1], Alexandria Alcantara[1], Kevin Lucht[2,3,4], Jose L. Mendoza-Cortes[2,3,4], Alexander V. Balatsky[5,6], and Jason T. Haraldsen[1], [1]Department of Physics, University of North Florida, [2]Condensed Matter Theory - National High Magnetic Field Laboratory (NHMFL), Florida State University, [3]Department of Scientific Computing, Materials Science and Engineering, High Performance Materials Institute (HPMI), Florida State University [4]Department of Physics, College of Arts and Science, Florida State University, [5]Institute of Material Science, Los Alamos National Laboratory, [6]Nordic Institute for Theoretical Physics, KTH Royal Institute of Technology and Stockholm University

P-38 SYNTHESIS AND CHARACTERIZATION OF LARGE AREA 2D-TAS_2/Cu(111) CATALYST FOR THE CONVERSION OF SYNGAS TO HYDROCARBON FUEL, Md Afjal Khan Pathan[1], Brett Young[2], Cody E. Jordan[1], Brandon Blue[1], Masahiro Ishigami[1], and Mihai E. Vaida[1,3], [1]Department of Physics, University of Central Florida, Orlando, Florida, 32816, United States, [2]Department of Chemistry, University of Central Florida, Orlando, Florida, 32816, United States, [3]Energy Conversion and Propulsion Cluster, University of Central Florida, Orlando, Florida, 32816, United States

ORGANIZING COMMITTEE

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