Light Sources Enabled Science Mini-Symposium
Room Ballroom BC - Session LS-ThP

Light Sources Enabled Science Mini-Symposium Poster Session

LS-ThP-1 Ultrafast Materials Characterization at the NSF-NeXUS Facility*, **Seth Shields**, Tim Scarborough, Conner Dykstra, John Beetar, Ziling Li, Roland Kawakami, Jay Gupta,* Ohio State University

The National Science Foundation (NSF) National eXtreme Ultrafast Science Facility (NeXUS) is a new open access user facility that provides access to extreme light to researchers around the world. The facility contains a mix of optical and analytical capabilities that allow for the study of chemical and material properties on the time scale of femtoseconds to attoseconds and on the length scale of angstroms. A customized high power, high repetition rate (800 W @ 100 kHz) Yb-doped fiber laser and pulse compression scheme from Active Fiber Systems GmbH is used to produce extreme ultraviolet light (XUV) through high harmonic generation. The XUV light is conditioned through three beamlines, which provide tailored light to a variety of end stations, three of which support materials analysis: X-ray absorption/reflection spectroscopy (XAS/XRS), Angle Resolved Photoemission Spectroscopy (ARPES), and Scanning Tunneling Microscopy (STM).

The combination of an ultrafast XUV beamline with more traditional condensed matter characterization tools, such as ARPES and STM, provides expanded capabilities for user experiments. ARPES is a surface sensitive technique that typically uses a helium discharge lamp to eject photoelectrons, and measurement of their energy and momenta allows for the study of electronic structure in reciprocal space. The addition of a beamline capable of providing light in an optical-pump XUV-probe arrangement allows the NeXUS ARPES to probe charge and carrier dynamics with sub-picosecond time resolution.

STM is a surface characterization technique used to study physical and electronic structure, with angstrom scale spatial resolution, by measuring the tunneling current across a nanoscale junction between the sample and an atomically sharp metal tip. At NeXUS, Thetailored light provided by the beamline addresses two long-standing weaknesses of STM measurements: poor time resolution (> ~1 μs), and lack of elemental specificity. The beamline allows for optical-pump probe measurements, which combine ~100 fs time resolution with angstrom scale spatial resolution of the STM. Additionally, XUV light can be tuned across an atomic core edge, resulting in a spike in photocurrent that is collected by the STM tip, yielding a spatially resolved elemental map of a surface.

This poster will present the preliminary results and progress during the commissioning and inaugural user experiments at NeXUS.

LS-ThP-2 X-Ray Measurements of ScB2, a Novel Substrate for Power Electronics*, **Jessica McChesney**, Amitayush Jha Thakur,* Argonne National Laboratory, USA*; Daniel Harrison2,* Morgan State University*; Ahamed Raihan,* morgan State University*; Evan Crites, Satya Kushwaha3, Tyrel McQueen,* Johns Hopkins University*; Michael Spencer,* Morgan State University*; MVS Chandrashekhar,* morgan State University

Power electronics play an increasingly important role in the push for electrification. Materials and devices that can handle large power loads with low loss, operate in extreme environments (including high temperatures), and are chemically and radiation-hard are required for a resilient grid. Wide-bandgap and ultrawide-bandgap materials, such as AlGaN, fill that role. However, there is a lack of suitable substrates for epitaxial growth. ScB2, a refractory metallic diboride, is a promising new substrate material, lattice-matched to Al0.5Ga0.5N (50% Al content), and offering a platform for engineering the band structure and thermal transport characteristics of a key III-V power-electronics material. We employed X-ray absorption spectroscopy (XAS), X-ray photoelectron spectroscopy (XPS), and X-ray diffraction (XRD) to probe and correlate measurements of electronic and atomic structure. In this talk, we will present initial crystalline quality and structural, electronic, and we will describe progress toward heterogeneous integration with AlxGa1-xN films.

LS-ThP-3 Light Induced Metastable States in 1T-TaS_2 Studies at the MAESTRO Beamline of the ALS*, Cheng Hu, Luca Moreschini,* Lawrence Berkeley National Laboratory*; Maximilian Huber, Alessandra Lanzara,* University of California at Berkeley*; Chris Jozwiak, **Aaron Bostwick**,* Lawrence Berkeley National Laboratory

The charge density wave material 1T-TaS2 has a complicated series of temperature dependent phases and in more recent years, it was discovered to have a insulator to metal transition that can be triggered by a single ultrafast laser pulse. This new metallic phase is thermodynamically metastable but very long lived at low temperatures. Here we employ the LASER-X facility at the MAESTRO beamline of the ALS, which combines an um focus ultrafast laser with sub-μm resolution angle resolved photoemission (nanoARPES) to explore the electronic states of the metastable state and stability of the metastable state at these small lengths scales. We find that within the resolution achieved by our experiment the excited state is homogeneous, and that the bottleneck to the sharpness of the boundary between metallic and insulating regions appears to be determined by the profile of the photoexcitation light pulse, and not by intrinsic material limitations.

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