Deborah Myers (Argonne National Laboratory) *High-resolution imaging of the spatial distribution of functional phases in proton-exchange membrane fuel cells and water electrolyzers*

Abstract: The performance of electrodes in electrochemical energy conversion devices, such as proton exchange membrane fuel cells and electrolyzers, depends on the properties of the electrodes phases and their interactions and spatial distributions. The enhanced capabilities of the upgraded APS can provide time-resolved atomic to meso-scale information on these phases and their evolution during fabrication and operation of these devices.

Feng Lin (Virginia Tech) *Designing electrode-electrolyte interfaces for electrochemical energy technologies*

Abstract: The continuously evolving electrode-electrolyte interface has posed great challenges for characterizing the dynamic interfacial process and quantitatively establishing the correlation with electrochemical performance. The presentation will highlight our recent studies investigating materials transformation at the electrochemical interface. We will also discuss the remaining challenges in achieving high spatial and temporal resolutions for thoroughly characterizing such interfaces.

Pietro Lopes (Argonne National Laboratory) *Resolving Composition Dynamics in Electrochemical Materials*

Abstract: As the changes in material composition can influence its local electronic structure and consequently its fundamental properties when used in electrochemical energy conversion and storage systems, direct observation of composition dynamics at the nanoscale can give us invaluable insights on how to design new materials that are simultaneously functional and stable. In this talk, we will discuss opportunities to resolve composition dynamics occurring in electrochemical environments by using the new capabilities being developed in the In Situ Nanoprobe and PtychoProbe beamlines as part of the APS-U project. We will discuss how visualizing in situ and real-time the composition distribution over 10-100 nm length scales of partial films of Au and Pt deposited over Ir(hkl) single-crystal surfaces as a function of electrochemical conditions can help us understand surface diffusion processes that are seemingly much faster in the electrochemical media than in gas-phase conditions. We will also discuss opportunities in understanding the formation of nanoscale vacancies and/or passive surfaces in 2D transition metal dichalcogenide thin films and their relationships to H2 production rates and surface deactivation that are important to guide the design of regeneration methods. A key enabler to these experiments will be the design of an in situ electrochemical cell that can accommodate single crystal and thin film samples, which we will also discuss in this presentation.

Yijin Liu (University of Texas, Austin) *In-situ imaging of the on-set and development of the layered oxide crystallization process under conditions relevant to battery cathode synthesis.*

Abstract: The synthesis and processing of crystalline layered oxides as battery cathode materials are highly complex, requiring a delicate process control. The effort to optimize this process is often conducted through trial-and-error, which is inefficient and expensive. In this talk, we will discuss the scientific and technical significance of this research topic and will present our conceptual design of a pioneering experiment that will benefit from the projected novel capabilities at the In Situ Nanoprobe (ISN) and PtychoProbe beamlines.

Paul Evans (University of Wisconsin, Madison) *In situ crystallization of nanoscale (epitaxial) functional complex oxides*

Abstract: The creation of epitaxial complex oxide nanomaterials holds promise for quantum electronic, magnetic, and optical technologies and presents scientific challenges associated with new phenomena in crystallization. Variations in the concentration of defects, density, crystallinity, and composition arise at scales on the order of tens of nanometers in these processes for which emerging in situ x-ray nano beam characterization techniques can provide an exciting perspective.

Ahmet Uysal (Argonne National Laboratory) *Understanding Graphene Based 2-D Material Interfaces for Heavy Element Separations*

Abstract: Graphene based 2-D materials are particularly promising for a range of applications including energy storage, catalysis, and separations. In these systems, fluid and ion interactions with happen within a few-nanometer region at the interface. This small region has vastly different properties compared to the bulk. Understanding the nanoscale interactions between ions and water near graphene and GO is critical for advancing our fundamental knowledge of these systems and downstream application success.

Roopali Kukreja (UC Davis) *Coherent x-ray scattering studies of quantum materials* (remote)

Abstract: I will discuss nanodiffraction techniques used by my group to investigate nanoscale properties of complex oxides heterostructures including cobaltites and nickelates. I will discuss our result on Gd/La0.67Sr0.33CoO3(LSCO) heterostructures, which have shown promises for magneto-ionic control of functional properties through the presence of oxygen getter layers such as Gd. I will also show some of our initial results on combining ultrafast laser excitation with nanodiffraction and discuss potential opportunities for future.

Yue Cao (Argonne National Laboratory) *Visualizing driven dynamics in next generation materials and devices*

Abstract: In this talk, we will discuss our recent work using in-situ and in-operando nanodiffraction to resolve dynamics in quantum material thin films. We show how these experiments enabled by coherent X-rays provides critical information of self-organization of domains beyond the average atomic structure. We will further discuss future opportunities at ISN and ptychoprobe.

Leora Dresselhaus-Marais (Stanford University) *X-ray Ptychography to Reveal the Microstructural Mechanisms of Ore Extraction Chemistry* (remote)

Abstract: Decarbonizing manufacturing requires that we rapidly redesign numerous antiquated processes used at vast scales today in metals production. For extraction metallurgy (~15% of global CO2 emissions), redesigning these C-intensive processes requires science and engineering to identify new extraction methods that can overcome heterogeneous competing processes in the wide spread of compositions prevalent to natural ores. I will give an example of how my group has leveraged the existing Velociprobe's unique resolution and quantitative electron-density maps for key insights into the interplay between sintering and chemistry that currently plagues C-free approaches to iron/steel production. I will use this example to illustrate the key opportunities the PtychoProbe could offer for steelmaking and other extraction problems for critical opportunities in decarbonization.

Oleg Gang (Brookhaven National Laboratory) *Designed 3D nanomaterials through programmable self-assembly* (remote)

Abstract: tbd

Rachel Chen (Northwestern University) *Structural Complexity and Defect Introduction in Colloidal Crystals Engineered with DNA*

Abstract: Nanoparticle building blocks functionalized with DNA enable programmable assembly to form habited colloidal crystals, which have intriguing properties for optical, physical, and chemical applications. Studying the structural complexity and programmed defects in colloidal crystals requires internal structure visualization made possible by X-ray ptychography imaging. Exploring colloidal crystal growth pathways with in situ X-ray imaging is of interest for furthering our fundamental understanding of what governs crystal formation

Heileen Hsu-Kim (Duke University) *Unraveling the Resource Potential and Environmental Risks of Coal Ash Wastes: Insights from Nanoscale Characterization*

Abstract: Coal ash residues are the solid wastes produced at coal fired power plants and represents one of the largest industrial waste streams in the United States. In this presentation, Dr. Hsu-Kim will discuss the enrichment of arsenic and selenium in coal fly ash, two toxic elements that pose risks for ecosystems near coal ash disposal sites. The chemical forms of arsenic and selenium in coal ash entail heterogeneous associations at the micro- and nano-scale, and this complexity helps to explain why the leachability of these elements from coal ash is not easy to predict. Dr. Hsu-Kim will also describe efforts to valorize coal ash by mining the material for valuable metals such as rare earth elements. The presentation will examine how nanoscale characterization of these wastes ash could help propel valorization opportunities for materials sustainability.

David Fenning (UCSD) *Probing Local Effects on the Making and Breaking of Optoelectronic Thin Films*

Abstract: tbd

Mariana Bertoni (Arizona State University) *Probing the evolution of local environments in II-VI thin films during processing, operation and aging*

Abstract: tbd

Lea Nienhaus (Florida State University) *Stressing Halide Perovskites: Nanoscale Investigation of the Properties of Perovskite Thin Films*

Abstract: Solution-processed perovskite thin films consist of small grains with a size of 20 - 2000 nm connected by grain boundaries. As a result, there is a vast inhomogeneity in the optical and electronic properties of the different grains/GBs within one film, which can reduce the achievable energy output. In addition, facile ion movement under external stimuli (light or electric fields) adds additional complexity to the system. To gain insight into the optoelectronic and structural response of the perovskite thin film to these external stressors present under operating conditions, we utilize

scanning tunneling microscopy (STM), optical STM and synchrotron-based X-ray absorption STM.

Michael Stueckelberger (Deutsches Elektronen-Synchrotron DESY) *Community proposals as an inclusive strategy for fast benchmark publications from first user experiments*

Abstract: For first experiments at the In Situ Nanoprobe, three Community Proposals are proposed that are openly communicated to the scientific community and everybody is invited to contribute. These Community Proposals target new benchmarks in the XRF sensitivity limit, X-ray excited luminescence of semiconductors, and multi-modal scanning X-ray microscopy of solar cells.