Workshop APS & CNM

Advances in Phase Retrieval Methods for High-resolution X-ray Imaging

Time:

Monday: 8:30am – 12:00pm

Tuesday: 8:30am – 11:45am

Date:

Monday, August 24, 2020

Tuesday, August 25, 2020

Workshop location:

Online

Organizers:

Saugat Kandel (Northwestern), Sid Maddali (ANL), and Ming Du (Northwestern University)

Description:

Phase retrieval is a numerical inversion method that enables lensless imaging of a physical scatterer from coherent diffraction data. Widely used in a variety of fields for x-ray, optical, and electron diffraction imaging experiments, it has played an important role in recent advances in high-resolution characterization of crystalline and non-crystalline materials. Phase- retrieval-based imaging methods are set to become even more prevalent once fourth-generation light sources, such as the APS-U and ESRF-EBS, come online. These sources will provide coherent flux orders of magnitude higher than what is currently available, enabling phase retrieval at energy and resolution regimes currently inaccessible. In this context, this workshop aims to cover recent advances and emerging computational ideas in phase retrieval and related methods that exploit beam coherence.

This workshop will provide a forum of discussion for recent advances as well as current and future challenges for phase retrieval applications in various coherent diffraction imaging subfields. We expect that this setting will allow researchers to identify shared challenges, and thereby develop collaborative approaches to further advance nanoscale coherent diffraction imaging methods.

Short Course D CNM

Thin Film Deposition Overview

Time:

8:30AM – 10:00AM

Date:

Wednesday, August 26, 2020

Course location:

Online

Instructors:

Liliana Stan

Description:

This course is designed as an introduction to fundamental concepts and operating principles for the deposition of thin films by physical vapor deposition or chemical methods, providing a broad overview of thin film deposition methods, their advantages and limitations. Understanding that all methods have their specific limitations and involve compromises with respect to process specifics and substrate material, helps determining the methods that are suitable for achieving the expected film properties. Deposition methods that are available at the Center for Nanoscale Materials (CNM) - sputtering, evaporation, ALD, and CVD - will be discussed in more detail.

Short Course A CNM

Fundamentals of High Aspect Ratio Pattern Transfer by Deep Reactive Ion Etching(DRIE) Processes

Time:

1:00PM – 3:00PM

Date:

Wednesday, August 26, 2020

Course location:

Online

Instructors:

Ralu Divan & Thomas Cecil

Description:

This course will discuss and demonstrate pattern transfer by dry etch DRIE. The applications of these processes are the transfer of 2D patterns in thin films and substrates and the micro- and nanofabrication of 3D structures in substrates. This course will also present new complementary technologies such as Fast Atomic Sequential Technology (FAST) and stripping and cleaning technologies.

Workshop APS

Multi-modal X-ray Techniques for Emergent Quantum Materials

Time:

Thursday: 9:00am – 5:00pm

Friday: 9:00am – 5:00pm

Date:

Thursday, August 27, 2020

Friday, August 28, 2020

Workshop location:

Online

Organizers: Philip J. Ryan (APS), Mingda Li (APS), Gilberto Fabbris (APS)

Description:

Multi-modal experiments represent an exciting frontier in condensed matter physics (CMP) as it enables a thorough investigation of emergent phenomena under complex and often difficult to exactly reproduce environments. The penetration depth of hard x-rays makes it particularly suited to multi-modality; it can be used in conjunction with a broad temperature range, external fields, electrical transport, optical pump, strain, micro-to-nano beam size or high beam coherence, etc. In this way, multi-modal hard x-ray techniques greatly expand the power of a sole scattering probe by directly extracting structure-property relation in emergent quantum materials, such as multiferroicity, topological materials, spintronics, unconventional superconductivity, and quantum criticality. We see this approach as highly beneficial to the US CMP community, providing complete access to the underlying physical phenomena that will drive future device engineering forward. However, multi-model experiments also lead to a wealth and variety of data that needs to be concomitantly analyzed. To this end, artificial intelligence (AI) has recently emerged as a promising avenue to enhance and accelerate data modelling. Understanding how to best implement multi-modal probes to best operate between large data methods and AI remains a mostly unexplored area.

This workshop will bring together leading experimentalists, theorists, and computational material scientists to introduce their latest progress on how a multi-modal metrology may benefit their own in-house research, driving CMP phenomena and microelectronic device functionality that will take advantage of such methodology employing brilliant x-rays with micron size beams. The confluence of those designing experiments, who will need to appreciate how large data sets will be analyzed, and those experts designing future intelligent analysis and modelling tools, who need to understand the realities of emerging experimentation capabilities, will enable a powerful shift of how we investigate phenomena that is currently beyond our capabilities.

Workshop SAT D

X-ray Ptychography Training Course

Time:

Monday: 9:30am – 12:30pm

Tuesday: 9:30am – 12:30pm

Date:

Monday, August 31, 2020

Tuesday, September 1, 2020

Course location:

Online

Organizers:

Junjing Deng (APS) and Jeffrey A. Klug (APS)

Description:

Ptychography is one of the coherent diffraction imaging (CDI) methods that is able to achieve high spatial resolution much higher than the illumination size. Using a scanning microscopy approach with overlapping scan spots, ptychography bypasses the isolated object requirement for conventional CDI so that it is able to image extended samples. Ptychography has quickly gained momentum as a powerful tool to deliver high-resolution images of samples in biology, material science, electronics, etc. As APS-U will provide more than 100-fold increase in coherent flux, we expect more and more existing and upgraded beamlines will utilize ptychography on their research. The goal of this training course is to introduce the basic principles of ptychography and experimental implementation, to summarize the evolution of the techniques and corresponding reconstruction algorithm development, and to highlight the potential application in the life and materials sciences.

Workshop APS & CNM

Autonomous Control of Experiments in the Microscopes and Light Sources of the Future

Time:

Tuesday: 1:30pm – 5:00pm

Wednesday: 1:30pm – 5:00pm

Date:

Tuesday, September 1, 2020

Wednesday, September 2, 2020

Workshop location:

Online

Organizers:

Mathew Cherukara (CNM), Subramanian Sankaranarayanan (CNM), Nicholas Schwarz (APS), and Chengjun Sun (APS)

Description:

The APS and CNM are positioned to help solve some of the most challenging and novel scientific questions facing the energy needs of the nation. The design of new materials to manipulate classical and quantum information with high fidelity and ultralow power consumption and the enabling of systems for efficient energy storage, transportation, and conversion that will drive the emerging economy based on renewable energy are just a few examples. Addressing these scientific opportunities will be aided by the intrinsic capabilities of APS-U era facilities along with new measurement techniques and technological advances in detectors.

These advances in sources and detectors (x-ray and electron) will result in orders of magnitude higher data rates, and increased complexity from multi-modal data streams.

Human-in-the-loop experiments become infeasible in the face of such large and varied data streams. As experiments progress to speeds where humans are too slow to make control decisions, adaptive control becomes imperative. This workshop is organized to discuss the

state-of-the art and potential of autonomous control of experiments. It provides an opportunity for academics, laboratory and facility staff, researchers, and students from both x-ray and electron characterization communities to exchange ideas and think creatively about new avenues for collaborations and advance autonomous characterization and experimentation.

Workshop APS

Advanced Spectroscopy Probes to Investigate Matter under Extreme Conditions - Opportunities Afforded by the MBA Lattice

Time:

Thursday: 9:30am – 1:00pm

Friday: 9:30am – 1:00pm

Dates:

Thursday, September 3, 2020

Friday, September 4, 2020

Workshop location:

Online

Organizers:

Mahalingam Balasubramanian (APS), Paul Chow (APS)

Description:

Advanced x-ray spectroscopy methods such as resonant x-ray emission and x-ray Raman scattering spectroscopies have provided critical breakthroughs in our understanding of matter under extreme conditions. The increased focusing capabilities afforded by the MBA lattice upgrade will undoubtedly create exciting, new opportunities to interrogate matter with exquisite detail under extreme conditions. In this workshop, we will bring together experts in field that encompass high pressure science and advanced spectroscopy methods. As we embark on transitioning to the upgraded synchrotron and beamlines, this workshop will explore the forefront science questions in high pressure science and provide valuable feedback to spectroscopy programs at the APS concerning the needs of the high pressure community and prevailing technological gaps.