Nano and 2D Materials
Room Naupaka Salon 5 - Session NM2-ThM

Nanomaterials - Properties and Applications II
Moderator: Yu-Chuan Lin, National Yang Ming Chiao Tung University (NYCU)

10:20am **NM2-ThM-8 2D Metal Carbides (MXenes) for Catalysis***, **Yue Wu**,* Iowa State University

MXenes, a new group of 2D transition metal carbides, are of considerable interest in catalysis due to their rich surface chemistry, tunable electronic structures, and thermal stability. In this presentation, we will discuss our latest discovery on utilization of metal-support interactions between noble metal and 2D metal carbides to enhance the catalytic reactions, such as alkane dehydrogenation, methane coupling, and electrochemical catalytic reactions. In addition, the nature of active sites in the MXene-based catalysts will be discussed.

10:40am **NM2-ThM-9 Investigating 2D-Materials Using Correlative Spectroscopy & Microscopy***, James Lallo, **Lu Ping**, Tim Nunney, Paul Mack, Robin Simpson, Hsiang-Han Tseng,* Thermo Fisher Scientific

Across a wide range of application areas, understanding the chemistry and structure of surfaces and interfaces is crucial. In the last fifty years, X-ray photoelectron spectroscopy (XPS) has become established as a one of the key techniques for measuring surface and interface chemistry, and advances in instrumentation have enabled it to keep pace with the requirements for both academia and industry. XPS can deliver quantified surface chemistry measurements, and by using depth profiling, an understanding of layer and interfacial chemistry, but the limit on spatial resolution for XPS can prevent it from determining how the surface structure is related to the measured chemical properties. For example, how the changing morphology of the surface during a depth profile could influence the measured composition would be challenging to determine using just XPS.

Other experimental techniques which are unable to match the surface selectivity of XPS are able to provide complementary information to extend the data from XPS. Electron microscopy can provide high resolution imaging, with elemental composition provided by energy dispersive X-ray microanalysis, but without the same surface selectivity seen with XPS or Auger electron spectroscopy (AES). This can be a perfect complement to XPS analysis, so long as the same points of interest can be identified. Molecular spectroscopy, such as FTIR or Raman, can also provide complementary information to XPS, albeit with different sampling depths, which can be extremely useful to validate measurements or confirm particular molecular structures using the wide range of spectral libraries available for those techniques.

In this presentation, we will describe how a correlative approach using both surface analysis instrumentation and scanning electron microscopy can be used to characterize 2D nanomaterials. Samples of MoS_2 grown on Si substrates have been investigated using XPS, Raman and SEM to determine their composition and structure. To facilitate co-alignment of the analysis positions when moving between the instruments, special sample carriers and software alignment routines have been developed.

11:00am **NM2-ThM-10 Electronic, and Optical Properties of 2D Metal Chalcogenophosphates***, Hung Chiu, **Santosh KC**,* San Diego State University

Recently, there have been significant research activities on two-dimensional (2D) materials for their potential use in electronic and optical devices. The structure, electronic, and optical properties of 2D metal chalcogenophosphates are investigated based on the Density Functional Theory. The lattice dynamics, surface, and interface properties with metal and oxides are investigated. Moreover, the electronic properties are tuned with substitutional impurities for metals and chalcogens. Our results indicate that the electronic and optical properties of metal chalcogenophosphates exhibit them as an emerging candidate material for devices.

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