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Abstract

Mechanism of Degradation of Phosphorene and its Stabilization via Hexagonal Boron Nitride Passivation

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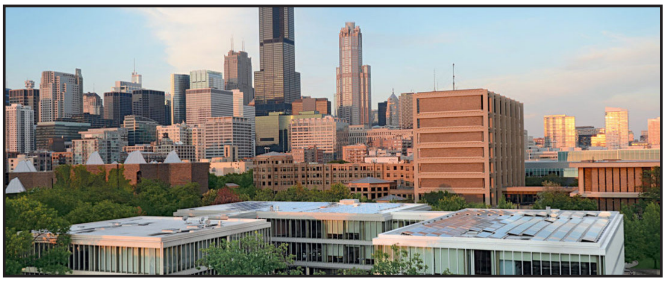
Abstract:

Layered crystals have revolutionized the field of nanoelectronics and optoelectronics due to their potential to be exfoliated into atomically-thin twodimensional (2D) surfaces (for example graphene from graphite). Phosphorene, a two-atom thick 2D material has found significant attention because of its unique properties including: sizable band gap (0.3-1.2 eV), in-plane anisotropy, and high charge carrier mobility. Further the 2D phosphorene layers can be easily exfoliated from the bulk 3D black phosphorus crystals and transferred onto any arbitrary substrate. However, the major problem associated with the technological applications of phosphorene is that these 2D material crystal structures can be deteriorated (unstable) in the ambient condition. In this thesis, we have studied the degradation mechanism of phosphorene and developed approaches to protect these anisotropic 2D crystals via creating sandwich structure with hexagonal boron nitride (h-BN) passivating layer. Confocal Raman characterization results indicate oxygen as a leading factor, with light as a catalyst causing the degradation nucleating at the edge of phosphorene and extending to the basal surface. In addition, the mass transfer model is applied to define the relationship between the oxidized film thickness and oxygen concentration with time dependent. The model and Raman results have interesting approach to have constant rate after long enough time of exposure to degradation factor. The oxidized film itself is prone to have ability to protect underneath phosphorene layers from degradation.

Biography:

Meghan Natechanok Yutthasaksunthorn is a researcher and works with one of the petrochemical company in Thailand. She holds a Bachelor degree and a Master of Science in Chemical Engineering at the University of Illinois at Chicago. During her time in the US, Meghan did research with Dr. Anirudha Sumant at Center of Na-



noscale Materials, Argonne National Laboratory. Besides, she has 3 years of industrial-scaled research for designing new materials. She is now awarded with Royal Thai Government Scholarship and going to pursue her Ph.D. in Chemical Engineering in the United States. Upon completion, she will go back to spearhead a promising government-funded pilot plant of bio-based and functional polymer, which will turn new page of polymer technology in Southeast Asia. These experiences and commitments she encountered as a young researcher gave her the motivations and the career aspirations to conduct dynamic research and eventually to make a difference. The culmination of her passions and her career goals is to contribute to Southeast Asia's overcoming of petrochemical and agricultural technology difficulties. She wishes to be one of the influential scientists whose work will transform crises and deficiencies into better changes for the society.

Publication of speakers:

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2. Yi Y., Yu X. F., Zhou W., Wang, J. & Chu P. K. Two-dimensional black phosphorus: Synthesis, modification, properties, and applications. Mater. Sci. Eng. R Reports 120, 1–33 (2017).
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