UNIVERSITY OF LOUISVILLE

COLLEGE OF ARTS & SCIENCES

Department of Chemistry

Brown and Williamson Series
November 3, 2023
@4:00 pm
CBLL16

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Metal Oxyhalide Intergrowths as Durable Photocatalysts

ABSTRACT:

Bismuth-containing mixed metal oxyhalides are promising layered photocatalysts for solar water splitting. These typically visible light absorbing materials have layered crystal structures that minimize electron-hole recombination that facilitate high performance. Here, new metal oxychloride intergrowths based on Bi_4MO_8Cl–Bi_2LnO_4Cl (M = Ta, Nb, V; Ln = Gd, La, Y) will be described. These intergrowths were prepared using a halide flux method, with their crystal structures analyzed by powder X-ray diffraction data and high-resolution scanning transmission electron microscopy. These analyses support intergrowth formation. The M/Ln molar ratio was systematically varied in the intergrowths to rationalize the effect of charge separation and changes in band structure toward photocatalytic water-splitting activity. Furthermore, select intergrowths are capable of sustained overall water splitting in a Z-scheme. Their standout feature is high photostability, which is attributed to the O 2p orbitals being positioned at the valance band edge rather than Cl 3p orbitals. These results provide new strategies for designing durable artificial photosynthetic systems by rational modulation of crystal and electronic structure. This talk will conclude with a discussion of new single-source precursors for the colloidal synthesis of bismuth oxyhalides as a start toward nanoparticles with defined structural features.

BIO:

Dr. Sara Skrabalak received her B.A. degree in chemistry from Washington University in St. Louis in 2002 where she conducted research with Professor William E. Buhro. She was the recipient of the Sowden Award in undergraduate research from the Department of Chemistry. She then moved to the University of Illinois at Urbana-Champaign where she completed her Ph.D. degree in chemistry in fall of 2006 with the tutelage of Professor Kenneth S. Suslick. There, she was the recipient of the T.S. Piper Thesis Award for her work on porous materials. She then conducted postdoctoral research at the University of Washington – Seattle with Professors Younan Xia and Xingde Li, designing nanomaterials for biomedical applications. She began her independent career in the Chemistry Department at Indiana University – Bloomington in 2008, where she was named the James H. Rudy Professor in 2015. She is a recipient of both NSF CAREER and DOE Early Career Awards. She is a 2012 Research Corporation Cottrell Scholar, a 2013 Sloan Research Fellow, a 2014 Camille Dreyfus Teacher-Scholar, and recipient of the 2014 ACS Award in Pure Chemistry and 2015 Baekeland Award. In 2017, she was named both a Fulbright Fellow and Guggenheim Fellow as well as the recipient of Research Corporation's Frontiers in Research Excellence & Discovery Award. In 2020 Professor Skrabalak was named a fellow of the American Association for the Advancement of Science and assumed the roles of Editor in Chief for both *Chemistry of Materials* and *ACS Materials Letters.* She is the Director of the NSF-funded Center for Single-Entity Nanochemistry and Nanocrystal Design. Her research group focuses on nanomaterial design and synthesis for applications in catalysis, solar energy use, secured electronics, chemical sensing, and more (https://skrablab.sitehost.iu.edu/).