Atomic-Scale Interface Studies of Supported 2D Transition Metal Dichalcogenide Nanocrystals

Michael Bedzyk and Supriyo Majumder

Materials Science and Engineering, Northwestern University, bedzyk@northwestern.edu, http://bedzyk.mccormick.northwestern.edu/

Abstract

2D transition metal dichalcogenides (TMDs) possess tunable bandgaps including indirect to direct bandgap crossovers, valley-selective optical excitations, photo-current switching, and controllable surface mobilities that are favorable for optoelectronics, flexible solid-state devices, field-effect transistors, ultrasensitive sensors, and efficient energy conversion applications. As is often the case for novel functional materials, one of the prerequisites for their successful integration into existing technologies is the ability to grow them in a desired fashion (structure, chemical composition, morphology, number of layers, etc.) For WS_2 TMDs grown by MOCVD on c-plane sapphire by our TAU collaborators, we combined surface X-ray diffraction and X-ray standing wave excited fluorescence and photoemission to produce a highly resolved chemically sensitive atomic description of the substrate terminal layer, interface layer, and 2D nanocrystal layer. This very recent X-ray work adds further information to our earlier TAU-NU publication.[1]

[1] Cohen, A.; Mohapatra, P. K.; Hettler, S.; Patsha, A.; Narayanachari, K. V. L. V.; Shekhter, P.; Cavin, J.; Rondinelli, J. M.; Bedzyk, M.; Dieguez, O.; Arenal, R.; Ismach, A., Tungsten Oxide Mediated Quasi-van der Waals Epitaxy of WS_2 on Sapphire. *ACS Nano* **2023**.

Short Biography

Michael Bedzyk is a Northwestern University Professor of Materials Science & Engineering and Physics & Astronomy (by courtesy). He presently serves as co-director of the Northwestern Synchrotron Research Center. He is a Fellow of the American Physical Society and the American Association for the Advancement of Science. He received the Bertram E. Warren Award for Diffraction Physics from the American Crystallographic Association. His PhD is in Physics from the State University of New York at Albany. Prior to Northwestern, he was a staff scientist at synchrotron X-ray facilities located at DESY in Hamburg, Germany, and then at Cornell University in Ithaca, New York. His research uses in situ X-ray scattering and spectroscopy for atomic-scale studies of interface processes and structures that form between various phases of matter. These include ion distributions at electrified liquid/solid interfaces, DNA-coated nanoparticles, oxide-supported catalytic nanoparticles, membrane formation by molecular assembly, functionalized 2D crystalline materials, strain in complex-oxide heterolayer structures, Li-ion battery solid-electrolyte interphase layer formation and superconducting films.