Scalable Nanomanufacturing of 2D Oxides – Transparent Semiconductors for Switching, Sensing, and Solar Energy

ABSTRACT

The future of ubiquitous electronics demands new technologies that are low-cost, multifunctional, and deeply integrated. For example, emerging applications in autonomous vehicles or advanced prosthetics call for rethinking how we design and manufacture electronics that seamlessly combine sensing, energy harvesting, and communication into 3D systems. S*calable nanomanufacturing* via printing technologies could deliver these multifunctional 3D systems by allowing low-cost integration of devices utilizing high-performing nanoscale materials.

In this talk, we present scalable fabrication of two-dimensional (2D) metal oxide semiconductors and explore the physics governing their applications to transparent transistors, 3D-printed sensors, and perovskite solar cells. These wide bandgap 2D transparent conducting oxides (In_2O_3, ZnO, and Ni_2O_3) are uniquely capable of driving technologies (displays, smart windows, etc) that benefit from their transparency and tunable electronic structure. We will first discuss the use of quantum confinement to control the electronic properties of 2D In_2O_3 semiconductors printed from the oxide skin of molten indium, leading to transparent transistors with ultrahigh electron mobility. Next, we will explore how 2D ZnO can be electrostatically engineered to accomplish low-power, multimodal sensing via atomic layer deposition onto 3D-printed polymers. Finally, we will demonstrate the use of 2D oxides to enhance the performance and reliability of planar inverted perovskite solar cells leveraging hole selective ultrathin NiO contact layers. To conclude, we will consider the possibilities for new materials and device architectures that control and exploit the interfacial properties of 2D conducting oxides.

Department of Physics
University of Vermont

Theoretical and Applied Physics

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William Scheideler, Ph.D.
Assistant Professor
Thayer School of Engineering
Dartmouth College

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4:00 PM

Innovation Hall

Room E432

Refreshments will be available at 3:30 PM. in Innovation E217

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BIOGRAPHY

Prof. William Scheideler graduated *summa cum laude* from Duke University in 2013 with B.S.E. degrees in Electrical Engineering and in Biomedical Engineering. He completed his Ph.D. as an NSF Graduate Research Fellow in Electrical Engineering at the University of California, Berkeley, where his doctoral thesis explored scalable nanomanufacturing of metal oxide electronics. He then completed his postdoctoral studies in the Department of Materials Science and Engineering at Stanford University, where he studied scalable fabrication and thermomechanical reliability of perovskite solar cells. William joined the faculty of Dartmouth College's Thayer School of Engineering as an Assistant Professor in 2019, launching the SENSE (Scalable Energy and Nanomaterial Electronics) Laboratory. His current research interests include 3-D nanomanufacturing and 2D materials for energy and sensing.

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