Abstract: Atomic Layer Deposition (ALD) is a powerful nanofabrication technique capable of depositing highly-conformal coatings for a variety of applications. ALD is based on a modified chemical vapor deposition (CVD) process, in which the overall chemical reaction is split into two sequential self-limiting half reactions. This allows for sub-nanometer precision in material thickness, which can be controlled with a resolution of ~1 Angstrom. Due to the self-limiting nature of the surface chemical reactions, ALD processes allow for perfect uniformity when coating high aspect ratios (above 2000:1), allowing for 3-dimensional engineering of complex nanostructured architectures. The atomically-precise tuning of surfaces and interfaces afforded by this process allow for numerous opportunities in the fields of semiconductor devices and memory, energy conversion and storage, MEMS/NEMS, catalysis, and other emerging areas.

This talk will present an introductory overview to the field of ALD, including the underlying surface chemistry, patterning, material characterization, and example applications. An emphasis will be placed on the benefits of this technique compared to standard thin-film processes, illustrating the numerous possibilities for application of ALD materials in novel areas. Materials systems that can be deposited include metal oxides, nitrides, sulfides, metals, and polymers. Both thermal and plasma-enhanced ALD processes will be discussed, with an explanation of the advantages of each. Nucleation of isolated particles will also be presented, allowing for fabrication of unique nanocomposite structures, such as inorganic nanowire/nanoparticle hybrid materials. The talk will conclude with a perspective on future research directions in the field.

Bio: Neil P. Dasgupta is an Assistant Professor in the Department of Mechanical Engineering at the University of Michigan. He earned his Ph.D. in Mechanical Engineering from Stanford University in 2011. Prior to joining University of Michigan in 2014, he was a postdoctoral fellow in the Department of Chemistry at University of California, Berkeley. He is the recipient of a U.S. Department of Energy EERE Postdoctoral Research Award (SunShot Fellowship), the AVS Student Award for Best Graduate Research in ALD, and a Stanford Graduate Fellowship. His current research focuses on the application of atomic layer deposition, semiconductor nanowires, and quantum confinement structures for energy conversion and storage devices.