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Understanding Atomic Layer Growth Processes Using *In Situ* Process Diagnostics

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Abstract:

Atomic layer deposition (ALD) is an ideal technique for depositing films that require angstrom-level control over the film thickness, chemical composition, and the interface with the underlying material. Due to surface reaction limited growth, ALD can also provide conformal coverage with sharp interfaces on high-aspect-ratio nanostructures. ALD has been used to deposit dielectrics, semiconductors, and metal films for various applications in semiconductor processing, energy conversion and storage, and catalysis. In this talk, I will discuss the use of in situ surface and gas-phase diagnostic tools to determine the surface reaction mechanisms during ALD of a variety of materials. In particular, I will focus on three different examples to demonstrate the critical role of in situ measurements in the development and understanding of ALD processes: (a) development of a novel plasma-assisted process for the low-temperature ALD of silicon nitride, (b) understanding the role of catalytic combustion reactions during ALD of ruthenium, and 3) determining the interface between crystalline silicon and ALD aluminum oxide for passivation of silicon-based solar cells.

Biographical Sketch

Sumit Agarwal is an Associate Professor in the Chemical and Biological Engineering Department at the Colorado School of Mines (CSM). He received his undergraduate degree from the Indian Institute of Technology – Varanasi, MS degree from University of New Mexico, and PhD from University of California – Santa Barbara, all in chemical engineering. After completing his post-doctoral research at the University of Massachusetts – Amherst, he joined CSM as an Assistant Professor in 2005. His current research is focused on the use of in situ diagnostics to develop a fundamental understanding of atomic layer deposition processes and during plasma processing of nanomaterials. Dr. Agarwal received the NSF CAREER award in 2009, and the Paul H. Holloway Young Investigator Award from the AVS in 2011 for his work on studying surface reactions during atomic layer deposition using in situ diagnostics.