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# Engineering Semiconductor Thin Films with ALD and Integrated Metrology

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The CHIPS and Science Act has accelerated the need for domestic semiconductor manufacturing capabilities built on precise thin-film deposition, scalable process control, and integrated metrology. Atomic Layer Deposition (ALD), with its angstrom-level thickness control and excellent conformality, is a critical enabler for next-generation logic, memory, and interconnect technologies.

This work presents a process-engineering and metrology-driven approach to metal and metal-oxide thin films developed through extensive hands-on experience with ALD and complementary vacuum deposition techniques. Rather than focusing on materials discovery, the emphasis is on establishing repeatable, manufacturing-relevant thin-film processes. Films are characterized using X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), X-ray reflectivity (XRR), atomic force microscopy (AFM), Raman spectroscopy, and spectroscopic ellipsometry to correlate deposition conditions with thickness, crystallinity, surface chemistry, and morphology.

By integrating multi-modal metrology with deposition process development, this work enables rapid feedback for recipe optimization, improved film uniformity, and enhanced integration readiness. Select electrochemical evaluations are used as secondary performance validation of film quality and stability. Overall, this approach demonstrates how ALD process engineering combined with comprehensive metrology directly supports CHIPS Act priorities by advancing scalable manufacturing workflows and strengthening the semiconductor workforce pipeline.

## Academic or Professional Status

Postdoctoral Researcher / Research Scientist

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