

# **Atomic Layer Deposition in Energy-Related Applications**

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Atomic layer deposition (ALD) is recognized as an advanced thin-film fabrication technique characterized by sequential, self-limiting gas-phase surface reactions. Through this unique growth mechanism, sub-nanometer precision in film thickness and composition is enabled, and highly conformal coatings on substrates with extreme aspect ratios can be achieved. Although ALD was originally developed to satisfy the stringent scaling requirements of the semiconductor industry, the technique has since been widely adopted across diverse technological fields. In particular, the exceptional uniformity, tunability, and chemical precision provided by ALD have established it as one of the most powerful approaches for engineering functional interfaces in modern energy technologies.

In this presentation, the fundamentals of ALD reaction chemistry and growth kinetics will first be introduced, including precursor design, nucleation behavior, and thickness control. Several research outcomes from our group will then be presented, covering applications in solar cells, batteries, and fuel cells. These examples collectively illustrate the versatility of ALD and highlight its strong potential for advancing a broad range of energy-related applications.