Atomic Layer Deposition: Surface Processes Unlocking Advanced Materials in the Semiconductor Industry

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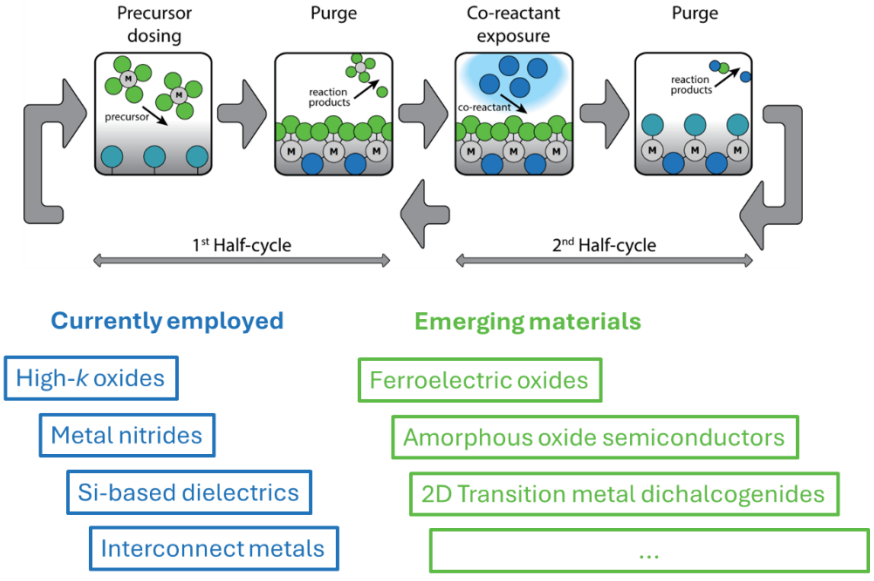
Atomic Layer Deposition (ALD) has emerged as a critical technique in the precise fabrication of materials employed in advanced semiconductor devices. ALD offers unparalleled control over film thickness, uniformity, and composition at the atomic scale, also on complex 3D structured surfaces that have become commonplace in the semiconductor industry. Understanding of the surface processes that govern ALD, including the intricate interplay of surface reactions, is fundamental to achieving high-performance materials for next-generation semiconductor devices in the so-called Ångstrom era. This presentation will delve into the fundamental aspects of the physics and chemistry at the surface during ALD and explore how surface processes dictate film growth and material properties. Focus will be given to emerging materials under ALD investigation, such as ferroelectric oxides, 2D transition metal dichalcogenides (TMDs), and amorphous oxide semiconductors, along with how advances in surface process understanding can address challenges in controlling the material properties and their scaling behavior.



Schematic representation of an ALD cycle for nanoscale film growth and an overview of material systems prepared by ALD as currently employed in the semiconductor industry or expected to be implemented within the upcoming technology nodes of the Ångstrom era.

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