

Tutorial on Area Selective Atomic Layer Deposition

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With the growing need for fabrication of nanostructures, area selective atomic layer deposition (AS-ALD) has become an active area of research and development as an additive process for achieving pattern features at the ~ 10 nm length scale for semiconductor applications. It is also being explored for its anticipated use in new applications within fields as diverse as catalysis and optoelectronics. This tutorial will begin by describing some of the pressing application needs that are driving the development of AS-ALD. It will also provide a brief historical perspective of the process, looking back at early work on AS-ALD as well as selective chemical vapor deposition. The central part of the tutorial will describe common strategies for AS-ALD, including the use of self assembled monolayer (SAM) blocking layers and small molecule inhibitors. These strategies will be illustrated with several examples of metal and metal oxide AS-ALD. These processes face limitations, and strategies for improving selectivity, such as repeated dosing of inhibitors and the integration of selective deposition with selective etching, will be described. The tutorial will overview metrologies useful for measuring selective deposition and will introduce metrics for quantifying selectivity. Finally, the presentation will end with a discussion of emerging challenges and opportunities for AS-ALD.