

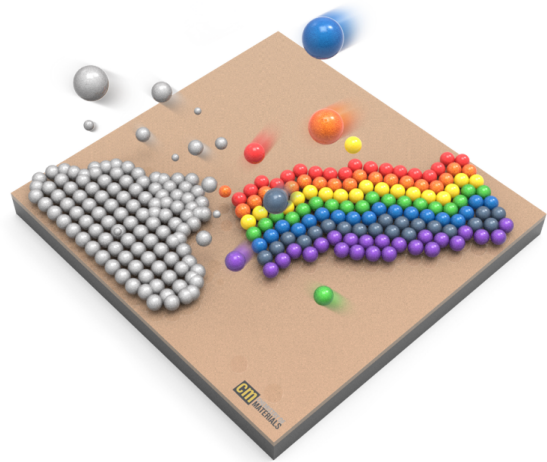
The 4th Tool Box for Semiconductor Device Nanofabrication beyond Atomic Layer Deposition

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Area-selective atomic layer deposition (AS-ALD) is envisioned to play a key role in next-generation nanofabrication for Si devices. Basics concept of AS-ALD is that an original surface is changed to activated or deactivated surfaces toward following ALD reactions, resulting in selective growth in one substrate. Although self-assembled monolayers (SAMs) have been successfully introduced for the change of surface properties and showed promising results in the early study of AS-ALD, they still have several disadvantages for high volume manufacturing (HVM), such as the low thermal



stability and pattern interference from their inherent size. Several years ago, our research group has suggested that many ALD precursors could be used for an inhibitor of AS-ALD by utilizing their adsorption selectivity on surfaces and reaction selectivity with counter reactant. Because the inhibitor, itself, is a precursor, it has high compatibility in HVM and multi-functionality between the roles of inhibitor and precursor. In this presentation, various types of precursor inhibitors studied in our group will be summarized and another opportunity of our AS-ALD will be discussed. A combined process of AS-ALD and atomic layer etching (ALE) was studied by designing process sequence and combination of inhibitor and counter reactants. In addition, another concept of selective deposition by using a homogeneous precursor inhibitor was proposed for thickness control of ALD thin films inside 3D structures. The chemical and physical interactions of inhibitors with precursors were successfully explained through theoretical calculations by density functional theory (DFT) and Monte Carlo simulation. The results could provide insights for the next generation nanofabrication in the semiconductor technology using ALD.