Towards New Applications of ALD
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Atomic layer deposition (ALD) has gained an important and rapidly increasing role in semiconductor industry. The main drivers for this growth have been the increasing needs of high conformality, uniformity and repeatability that derive from the device development toward increasingly three-dimensional structures and smaller layer thicknesses. In addition, introduction of new materials and novel patterning techniques have opened for ALD fast lanes to production.

ALD technology consists of two main components: reactors and processes. As the reactors have reached a level meeting industry specifications, the future of ALD will depend mainly on introduction of new processes. Indeed, the success of ALD is built on chemistry: the unique benefits of ALD can be exploited only when proper precursors undergoing saturative surface reactions can be identified for the material of an interest. Development of ALD precursors and processes has therefore been in a central role over the entire history of the ALD technique. The review of Miikkulainen et al. [1] lists 780 ALD processes for 160 materials with 300 metal precursors, yet there are lots of important materials that lack ALD processes and also many of the existing ones call for improvement. This presentation will discuss future directions and challenges in ALD process and precursor development.

In the metal precursor development, the emphasis has shifted toward heteroleptic precursors but some valuable homoleptic compounds have also remained unexplored. Also new ways of combining metal compounds have been found. Among the nonmetal precursors alkylsilyl compounds have opened a range of new possibilities from phase change materials to thermoelectrics and beyond.

Plasma ALD has gained a lot of interest during the past decade allowing deposition of many materials inaccessible by thermal means as well as lower deposition temperatures. Photons could offer an alternative way for activating ALD chemistry but this has remained so far quite unexplored and a lot of work is needed to explore if photo ALD can offer benefits such as low deposition temperature, novel growth chemistries and selective area deposition.

One may also need to accept that certain materials remain too challenging to be deposited by ALD. Even then the benefits of ALD may possibly be enjoyed by developing an indirect route where a precursor film is deposited by ALD and then converted to the desired material by some other means.

Organized by:

[1] V. Miikkulainen, M. Leskelä, M. Ritala and R. L. Puurunen, J. Appl. Phys. 113 (2013) 021301.