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Atomic Layer Processing: A toolbox for fabricating novel functional hybrid materials

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Abstract

Atomic layer processing is an umbrella term for several processing techniques that base on atomic layer deposition (ALD). Those include thin film coatings with inorganic or organic materials, atomic layer etching and polymer infiltration strategies.

The ALD process can be seen from various perspectives. On the one hand, it allows controlled deposition of thin films on a variety of substrates and in this way enables a modification of a given functionality of a surface or even introduction of a new functionality. On the other hand, it may be seen as a chemical reactor that allows precise dosing of a chemical, allowing for chemical interaction and modification of the substrate. Considering both points of view, the process opens large variation possibilities for a design of novel functional materials for emerging applications and devices. Among those functional materials hybrid materials play an increasingly important role. Hybrid materials are in most cases blends of inorganic and organic materials and are considered to be key for the next generation of materials research. The main goal while fabricating such materials is to bridge the worlds of polymers and ceramics, ideally uniting the most desirable properties within a singular material. Furthermore, in a well performing hybrid material the individual components will add value to their counterpart in a synergistic way.

In this talk, some approaches will be discussed that show great promise for establishing ALD as the method-of-choice for innovation in technological fields beyond the microelectronics industry. Examples, where mechanical and electronic properties of polymeric materials have been significantly improved through nanoscale coatings and infiltration, will be shown. Those polymers include natural polymers as well as synthetic polymers, which are hybridized with inorganics from the vapor phase.