Tutorial Title:

ALD Precursors, Precursor Design, Chemistry and Mechanisms

Abstract:

ALD precursors and reactivities have been reported for a range of materials, including selected metal oxides, metal nitrides, and elemental metals. However, many materials (e.g. many pure elements) remain inaccessible by ALD, and in other cases, existing ALD methods are unsuitable for industrial application due to insufficient precursor thermal stability at the delivery temperature, problems with precursor scale-up, an unsuitably narrow ALD temperature window, poor nucleation or adhesion on industrially relevant substrates, high deposition temperatures which cause substrate damage or thin film agglomeration, use of unselectively reducing co-reactants which cause substrate degradation, parasitic CVD growth, an unacceptably low film growth rate per cycle, impractical deposition conditions (e.g. extremely long pulse or purge durations, or a requirement for UHV), or the formation of thin films with undesirable morphology, crystallinity or purity. Consequently, there exists a requirement for new precursor and reactivity development for ALD of a broad range of materials. In this tutorial, ALD precursor and reactivity design strategies will be illustrated using examples from recent literature, with a focus on metal ALD employing unique precursors and reactivities. Furthermore, the utility of solution studies for reaction screening, and as a means to gain mechanistic insight into the reaction pathways responsible for thin film deposition, will be discussed.

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