NOVEL PRECURSORS FOR HIGH K DIELECTRICS AND METAL ELECTRODES
PART I: SYNTHESIS

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Rapid scaling of semiconductor devices toward the sub-100 nm generation has produced the need for the development of alternative materials due to high leakage currents observed with thin traditional silicon-based structures. There are many challenges facing the adoption and integration of these new thin films including charge trapping (V_t flatband voltage shifts upon stressing), dopant diffusivities (e.g., boron), and mobility degradation (related to interfacial layer thickness). Along with the film material itself and the process utilized for deposition, a key factor for the implementation of high K components is the precursor material.

In a closely related area, another developing trend resulting from shrinking device feature size is the movement toward thin film formation by chemical vapor or atomic layer deposition (CVD or ALD). With an increase in complex surface topographies and high aspect ratios, these techniques will be required to maintain high uniform and conformal coverage.

These two industry trends in combination provide an impetus for the production of candidate CVD/ALD precursors. As with the film properties themselves, there are challenges developing a suitable precursor as well. Issues with safety, purity, volatility, and compatibility must be addressed. Two potential applications for these new materials include the replacement of SiO_2 as the dielectric material and poly-Si as the electrode. In this discussion we will look at platinum as a potential electrode and hafnium and silicon compounds for the dielectric material. Tuning the properties, including melting point and volatility as well as the purity and compatibility, of these precursors will be explored.