Synthesis and Integration of Functionally Enhanced Complex Material Systems

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The introduction of novel and functionally improved materials into silicon based integrated circuits is a major driver to enable the continued down-scaling of circuit density and performance enhancement in analog, logic, memory and sensing devices. Many novel materials, such as complex metal oxides, magnetic materials and phase change materials, are introducing new and unique functionalities that can enable continued technological advancement. The demand of engineering and precision control of these multi-functional materials and their interfaces at an atomic level has grown immensely due to their versatile applications. However, many of these materials are much harder to pattern, thereby posing significant challenges to their large scale integration. In this talk, I will discuss current research advances in atomic layer deposition for synthesizing multifunction and complex metal oxides with tailored electronic, chemical, interfacial, thermal properties and microstructures. Specifically, I will highlight our most recent research on the engineering of multi-ferroic materials for applications in memory, antenna and motors. For integration, I will discuss a generalized approach based on combined thermodynamic assessment and kinetic validation to aid the selection of viable etch chemistry leading to enable the high fidelity pattern transfer for large scale integration.

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