The programmed assembly of nanoscale building blocks offers exciting new avenues to create materials in which structure and functions can be chemically designed and tuned. In this context, the synthesis of inorganic molecular clusters with atomically defined structures, compositions and surface chemistry provides a rich family of functional building elements. This presentation will describe our efforts to assemble such “designer atoms” into a variety of hierarchical structures in which the preformed clusters emulate the role of atoms in traditional “atomic” solids. The resulting materials offer a unique opportunity to combine programmable building blocks and atomic precision. As such, they bridge traditional crystalline semiconductors, molecular solids, and nanocrystal arrays by synergizing some of their most attractive features. Recent synthetic advances to develop this concept into a “modular” platform for materials design will be presented, along with some of the unique collective material properties (magnetic, optical, electrical and thermal transport) that emerge as a result of the atomic precision of the crystal lattice and the specific interactions between the building blocks. The presentation will conclude with an assessment of future developments.

Hosted by Ann McDermott