TOWARD AN UNDERSTANDING OF THE REACTIVITY AND PROPERTIES OF NANOPARTICLES

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The chemical and reactive properties of nanoparticles span an interesting middle ground between the properties of individual atoms and molecules on one hand and bulk materials on the other. Unique properties compared to atoms or bulk systems can arise in nanoparticles for several reasons. For example, the fact that a high percentage of atoms in small nanoparticles are at or near the surface affects their reactivity. The fact that atoms and molecules are confined in structures of dimensions smaller that the characteristic length scale of some properties also leads to novel behaviors. Yet, many fundamental questions remain unanswered regarding what controls reactivity and processes on the nanoscale. In this talk, I will discuss emerging results demonstrate that the reactivity and properties of nanostructures can be affected by many factors including composition, geometry, electronic structure, spin, substrate interactions, fluxionality, defects, and interactions with neighbors. It will be seen that a small number of key active sites can dominate the observed properties and behaviors. Examples will be given of the unique reactivity and catalytic properties of size-selected nanosized metal clusters, plasmonic properties of nanoparticles, and of the flexibility available to control these properties.