“Size Effects of Matter: From Clusters to Nanoparticles”

The electronic and geometric structure and related dynamic phenomena of condensed matter depend sensitively on the size and chemical composition of the nanoscopic object. Free clusters containing a small number of atoms or molecules represent simple model systems, which are well-suited to study structural and dynamic size effects in comparison with the corresponding isolated species. Experimental results will be presented, where the local surroundings of an absorbing site within a cluster is selectively excited and probed by tunable soft X-rays. Model calculations and spectral simulations are used to relate size effects in electronic structure and dynamic processes of the occupied and unoccupied states to the local geometric structure.

Nanoparticles and quantum dots cover the size regime beyond small clusters. They are prepared by approaches of colloidal chemistry, where optical and magnetic probes are embedded in larger nanoparticles of well-defined size, shape, and composition. Novel experimental approaches are presented, which yield size-dependent properties of isolated nanoparticles in the gas phase. These serve for the fundamental understanding of variable size matter beyond small clusters. Possible applications of structured nanoparticles in materials research and life science are briefly discussed.