“Atomically Precise Fluorescent Metal Nanoclusters: From Synthesis to Therapeutic Applications”

The synthesis and isolation of atomically precise gold and silver clusters have been recently an exciting area of research in materials science. This is especially true for aqueous soluble clusters that typically display more challenges in achieving pure, atomically precise samples, and in crystallization for characterization. Owing to their tunable optical, electronic, and physiochemical properties, thiolate-protected gold clusters have been highly attractive for biomedical applications compared to traditional gold nanoparticles. In particular, Au nanoclusters emitting in NIR window have been studied for *in vivo theranostic* applications. Before any clinical use, it is important to ascertain that these clusters are pure and single size, to be able to track them in cells and understand their function in the body. However, the typical synthesis of these clusters often leads to a distribution of sizes with various number of metal atoms and ligands. The work presented will focus on light activated synthesis of novel atomically precise Au nanoclusters followed by an accelerated size-focusing step using a sequence of peptides as a ligand. Norrish type I photochemistry is used to control the reduction step of the cluster synthesis. The optical purity of the clusters is described using fluorescence excitation-emission matrix (EEM) spectroscopy and Parallel factor (PARAFAC) analysis. The excited state reactivity of the clusters along with preliminary results on their therapeutic activity are also described. The results demonstrate the potential of these novel Au clusters to be used as radiosensitizers in radiation therapy.