Unveiling the new synthetic mechanism of water-soluble, thiolate-protected gold nanoclusters by tracking all species during the reduction

김지수, 강성수, 박정원†
서울대학교
(jungwonpark@snu.ac.kr†)

Gold nanoclusters(Au NCs) have attracted tremendous attention owing to their molecule-like optical properties originated from strong quantum confinement effects, and their atomic precision which far exceeds the monodispersity of normal nanoparticles. So far, Au NCs are known to be synthesized via two consecutive reduction reactions. Au(Ⅲ) precursors are firstly reduced by thiol ligands forming Au(Ⅰ)-SR complexes, and those complexes are secondly reduced by reducing agents like$NaBH_4$ forming Au NCs. However, specific mechanism explaining the sequential reduction remains elusive. Detailed questions including which Au(Ⅰ)-SR complexes actually act as a precursor to the Au NCs, or how the ultrasmall size of Au NCs can be achieved and preserved during the reduction are still left unanswered. Herein, we reveal a new synthetic mechanism of Au NCs by delicately controlling several factors which can affect the amount of Au-containing species during the synthesis. We hypothesize that remaining Au(Ⅲ) species actually act as a precursor to the ultrasmall core of Au NCs, and specific Au-SR complexes act as a protector of the as-synthesized core to prevent further growth or dissolution.