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Roles of thiolate ligands in the synthesis, properties and catalytic application of gold nanoclusters (Review)

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Abstract

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Ultrasmall (<2 nm) ligand-protected metal nanoclusters (NCs) have been an emerging class of functional materials with rich coordination chemistry, finding increasing acceptance in both basic and applied research owing to their atomic precision, well-defined molecular structure, and intriguing molecular-like properties. The presence of ligands on metal NCs is crucial not only for maintaining their atomic precision and well-defined structure, but also for their rich coordination chemistry with noble metals, influencing the synthesis, and physicochemical and catalytic properties of metal NCs. In this review, we discuss the important roles of ligands to metal NCs, taking water-soluble gold nanoclusters (Au NCs) as an example. The review covers the fundamental understandings (and advances) on the roles of ligands to water-soluble Au NCs in the synthesis (e.g., influencing the size and formation rate, and revealing the growth mechanisms), physicochemical properties (e.g., geometrical structure, chirality, stability, solubility, and electronic, photoluminescence and biological properties) and catalytic applications (e.g., accessibility, activity, selectivity, and coordination of catalytic mechanism of quasi-homogeneous catalysts and immobilization of heterogeneous catalysts). The review also highlights some challenging issues on how ligands and ligand engineering could expand the scope of metal NCs in the synthesis, physicochemical properties, and catalytic application. © 2018 Elsevier B.V.

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