

第7回精密無機材料化学研究セミナー

演題 Atomically precise surface engineering of metal nanoclusters for biomedical and catalytic applications

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場所 南総合研究棟2号館セミナー室 (4階)

主催 多元物質科学研究所 精密無機材料化学研究部門



講演内容

Atomically precise metal nanoclusters represent the missing link between organometallic complexes and crystalline metal nanoparticles, offering an ideal paradigm to understand the physicochemical properties evolution of metal nanomaterials. Recent advances in synthesis and characterization chemistry suggest metal nanoclusters possess hierarchical structures akin to those of natural proteins, where the organic protecting ligands can organize themselves into well-defined patterns based on delicate supramolecular interactions. In this talk, we demonstrate that the supramolecular interactions among protecting ligands, counter ions, and external structure regulating agents can be leveraged to manipulate surface structure of metal nanoclusters, which can further exert effects on the overall sizes, structures, self-assembly architectures, and applications of metal nanoclusters. Building upon the mutual structure dependence of metal core and protecting shell of metal nanoclusters, a supramolecular interaction assisted surface engineering approach is developed to independently regulate the size, atomic packing structure, and surface chemistry of metal nanoclusters. By controlled ligand displacement reactions, we are able to program the functionality, charge density, and ligand rigidity on the surface of metal nanoclusters, influencing their targeting effects and luminescent performance in biomedical applications. Moreover, we exemplify that the ligand type, ligand number, ligand body orientation and arrangement can be collectively tuned for manipulating the electronic density, accessibility, and microenvironment of active metal sites, facilitating their applications in catalytic reactions of current interest (e.g., CO₂ reduction, oxygen reduction, hydrogen evolution, etc.).

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