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Metal nanoparticles with atomically chiral lattices and optical activity

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Abstract

Chiral nanoparticles (CNPs) have recently evoked increasing interest in nanomaterial sciences and technology, mainly due to imposing the chirality on nanomaterials. Metal and semiconductor CNPs have been generally produced through the induction by chiral ligands. However, the coexistence of chiral ligands will unavoidably screen the contribution of CNPs to the chiral interactions with (chiral) molecules. Alternatively, my group recently devised a versatile method, glancing angle deposition (GLAD) with fast substrate rotation, to fabricate metal CNPs with no use of chiral ligands. Macroscopic shear forces, applied by the substrate rotation in clockwise and counterclockwise along with the translation of incident atoms, lead to the generation of chiral lattices at atomic scales in the righthanded and left-handed, respectively, in the CNPs and at their surfaces. The inherent chiral lattices cause metal CNPs to have optical activity, denoting the differential interaction with left- and righthanded circularly polarized light. Unary CNPs deposited by GLAD, functioning as a chiral host, have been treated by galvanic replacement reactions and layer-by-layer GLAD to produce multi-principal element alloy CNPs whose constituent elements, composition, morphology, chirality, phase, and size are engineerable. The atomically chiral lattices at their surfaces give rise to enantiospecific adsorption of molecules and result in an enantioselective amplification of molecular optical activity, which is practically desired for sensitive detection of chiral molecules. Moreover, metal CNPs have served as asymmetric catalysts to, e.g., mediate photo-induced enantioselective cyclodimerization of 2- Anthracenecarboxylic Acid. These results provide an insight into applying metal CNPs to potential applications in the practically vital fields of bio-imaging, bio-sensing, disease diagnosis, and chiral drug production.

Biography

Dr. Zhifeng Huang is assoc. prof. in department of physics and associate director (Nanomaterials) in golden meditech centre for neuroregeneration sciences, at Hong Kong baptist university. Dr. Huang is Member of The Hong Kong young academy of sciences, and serves as vice president in hong kong materials research society. He focuses on the investigation in fabricating sculptured nano thin films and developing their applications in the fields of chiral plasmonics, enantiodifferentiation, asymmetric catalysis, optoelectronics, green energy generation, and stem cell differentiation. He published his works in high-impact journals, such as nat. *nanotechnol., annu. rev. phys. chem., adv. mater., adv. funct. mater., nano lett., j. am. chem. soc., adv. sci., small,* and *nanoscale*. dr. huang, together with prof. ken yung (department of biology, hkbu), co-founded a spin-off, mat-a-cell ltd., to commercialize a new-generation medical device for cell culture.

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