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CIC biomaGUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

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Mechanistic Investigation of the Seeded Growth of Chiral Gold Nanoparticles

Wednesday, 27th November
12.00 p.m.

CIC biomaGUNE - Seminar Room

The theme that connects the objectives of this work is the seeded colloidal synthesis of chiral plasmonic nanomaterials. A stepwise synthetic approach using smaller pre-prepared gold particles as the seeds for further growth enables the production of monodisperse colloids of nanoparticles that shine intensely in the entire visible spectrum and beyond.1 Introduction of a chiral molecule into a seeded colloidal synthesis of plasmonic nanomaterials grants access to more complicated twisted particle morphologies and correspondingly more interesting optical signatures.2-4 However, the mechanisms by which chiral growth occurs are not as well established as those for growth into achiral morphologies.

Aiming to expand our understanding of the growth mechanisms of chiral plasmonic nanoparticles, this thesis is separated into four distinct projects.

I. The modulation of chiral growth based solely on the concentration of a novel chiral inducer was explored, with the results suggesting an expanded role for the design of chiral molecules when preparing nanomaterials with different chiral morphologies.

II. The influence of seed geometry on chiral syntheses was investigated by contrasting the products of well-established growth mechanisms (chemically-induced or micelle-directed, see **Figure 1**) and using single-crystalline and pentatwinned achiral nanorods as seeds.

III. Using NaBH4, chiral reactions in progress could be ceased, and the products from varying intervals of growth could be isolated and characterized; this helped to define relationships between the observed chiroptical signature of products and their developing chiral features.

IV. Inspired by the hierarchical chirality expressed in the natural world, chiral products were used as the starting seeds in a subsequent chiral reaction to form products with different “core-shell” chiral features.

Overall, we systematically tested different synthetic variables to optimize chiral growth, and pushed the methodological boundaries for both the investigation and production of new chiral morphologies.

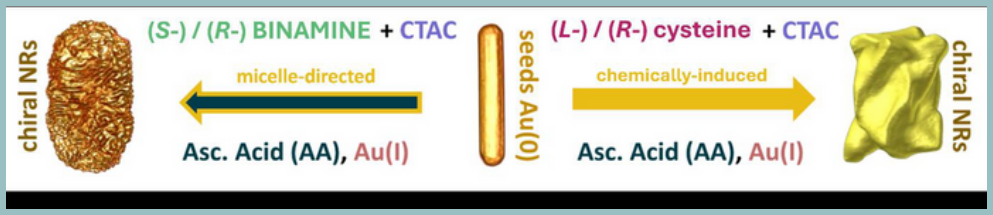

Figure 1. Mechanistic overview of chiral overgrowth reactions on gold nanorod starting seeds. Depending on the chiral inducer and synthetic conditions, chiral growth can progress very differently, resulting in products with intricate morphologies and intense chiroptical signatures. Adapted from ref. 2 and ref. 3.

References: 1. Jana, N. R., et. al., Adv. Mater. 2001.
2. Ni, B., et. al., Adv. Mater. 2023.
3. González-Rubio, G. et. al., Science 2020.
4. Lee, H.-E., et. al., Nature 2018.