Tailoring Asymmetric Coordination in Single-Atom Catalysts for Highly Efficient and Selective Photocatalytic CO_2 Reduction

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ABSTRACT

From the early stages of my academic journey, I discovered a strong and enduring interest in materials science, particularly in how the structural and electronic properties of materials influence their catalytic behavior. This initial curiosity led me to explore both photo- and electrocatalysis during my earlier research experiences, where I gained valuable exposure to catalyst synthesis, surface characterization, and reaction analysis. I am fortunate to have joined Advanced Material laboratory, which aligns closely with my long-term research goals and provides an excellent environment to expand my expertise.

My current work focuses on photocatalysis, with a particular emphasis on developing advanced functional materials for CO_2 reduction. I am especially interested in understanding how the precise design of active sites can influence catalytic pathways, selectivity, and overall reaction efficiency. This interest naturally led me to investigate single-atom catalysts (SACs), which have emerged as a transformative class of materials due to their nearly complete metal atom utilization, well-defined coordination structures, and highly tunable electronic properties.

In my preliminary studies, I am examining atomically dispersed metal centers embedded within a hollow g-C_3N_4 matrix. By engineering an asymmetric local coordination environment around the metal–nitrogen sites, we aim to modulate their electronic structure and enhance CO_2 reduction activity. Early observations suggest that this strategy provides a simple yet effective way to tailor catalytic performance. Moving forward, I plan to continue exploring innovative material preparation methods and deepening my understanding of structure–activity relationships to advance efficient photocatalytic CO_2 conversion systems.

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