Regulation of Electrocatalysts Based on Confinement-Induced Properties

Wei Ding

Affiliation: School of Chemistry and Chemical Engineering, Chongqing University, Chongqing 401331, China.

Email: dingwei128@cqu.edu.cn

Abstract: The development of highly efficient and low-cost electrocatalysts is important for both hydrogen- and carbon-based energy technologies. The electronic structure and coordination features, particularly the coordination environment and the amount of low-coordination atoms, of the catalyst are key factors that determine their catalytic activity and stability in a particular reaction. The regulation and rational design of catalytic materials at the molecular and atomic levels are crucial to achieving precise chemical synthesis at the atomic scale. Recently, significant efforts have been made to engineer coordination features and electronic structures by reducing the particle size, tuning the composition of the edges, and exposing specific planes of crystals. Among these representative strategies, the methods based on the confinement effect are most effective for achieving precise chemical synthesis with atomic precision at the molecular and atomic levels. Under molecular or atomic scale confinement, the physicochemical properties are largely altered, and the chemical reactions as well as the catalytic process are completely changed. The unique spatial and dimensional properties of the confinement regulate the molecular structure, atomic arrangement, electron transfer, and other properties of matter in space. It not only adjusts the coordination environments to control the formation mechanism of active centers, but also influences the structural and electronic properties of electrocatalysts. Therefore, the adsorption of catalytic intermediates is altered, and consequently, the catalytic activity and selectivity are changed. The catalysts, produced by confinement significantly differ from those produced in an open system, showed unique advances in the field of fuel cells and material energy conversion.

References:

[1] Wei Ding*, Zidong Wei*. et.al. *J. Mater. Chem. A*, **2020**. 10168-10174

[2] Wei Ding*, Zidong Wei*. et.al. *Nature catalysis* **2020**, 454-462

[3] Wei Ding*, Zidong Wei*. et.al. *Chem.* 2020. 6, 431-447.

[4] Wei Ding,* Li Li,* Zidong Wei*, et.al. *Angew. Chem. Int. Ed.,* **2018,** 57, 15101.

[5] Wei Ding,* Li Li,* Zidong Wei*, et.al. *Angew. Chem. Int. Ed.* **2016**, 55(4), 1340-1344.

Biography:

Prof Wei Ding received his M.Sc and Ph.D in 2011 and 2014, respectively from Chongqing University, China. After graduation, he joined Chongqing University in 2014 and promoted as an Associate Professor in 2016 then Professor in 2021. Currently, he is the associate dean of the College of Chemistry & Chemical Engineering, Chongqing University. His current research interests include electrocatalysis for fuel cells and energy conversion technology. The main academic idea is to develop strategies to confer skills which existed in the limited space or dimensions on catalysts. Based on this idea, the following strategies or academic thought were achieved, including: a) 2D-space-confinement- induced synthesis with controlled molecular structure or atomic arrangement, b) the synthesis of free-standing and self-stable single atom layer metal crystal, c) the invention of shape fixing via salt recrystallization method to bridge the gap between macromolecular structures and active carbon architectures with controlled morphologies and complete exposure of all active sites, d) the use of dissimilar effect to give catalysts high activity and anti-poising capabilities. In the recent five years, the representative papers was published mostly in top chemistry, energy and chemical engineering journals, including Nature catalysis, Chem, JACS, Angew，ACS Energy letters， ACS Catalysis, Chem. Engin. Sci. He had been awarded the 1st prize of Chongqing Natural Science Award in 2017(the fourth of five accomplishers), and founded as Chongqing Top Young Scholars in 2019 and The National Science Fund for Outstanding Young Scholars in 2020, respectively.