Tuning strategies and structure effects of electrocatalysts for the carbon dioxide reduction reaction

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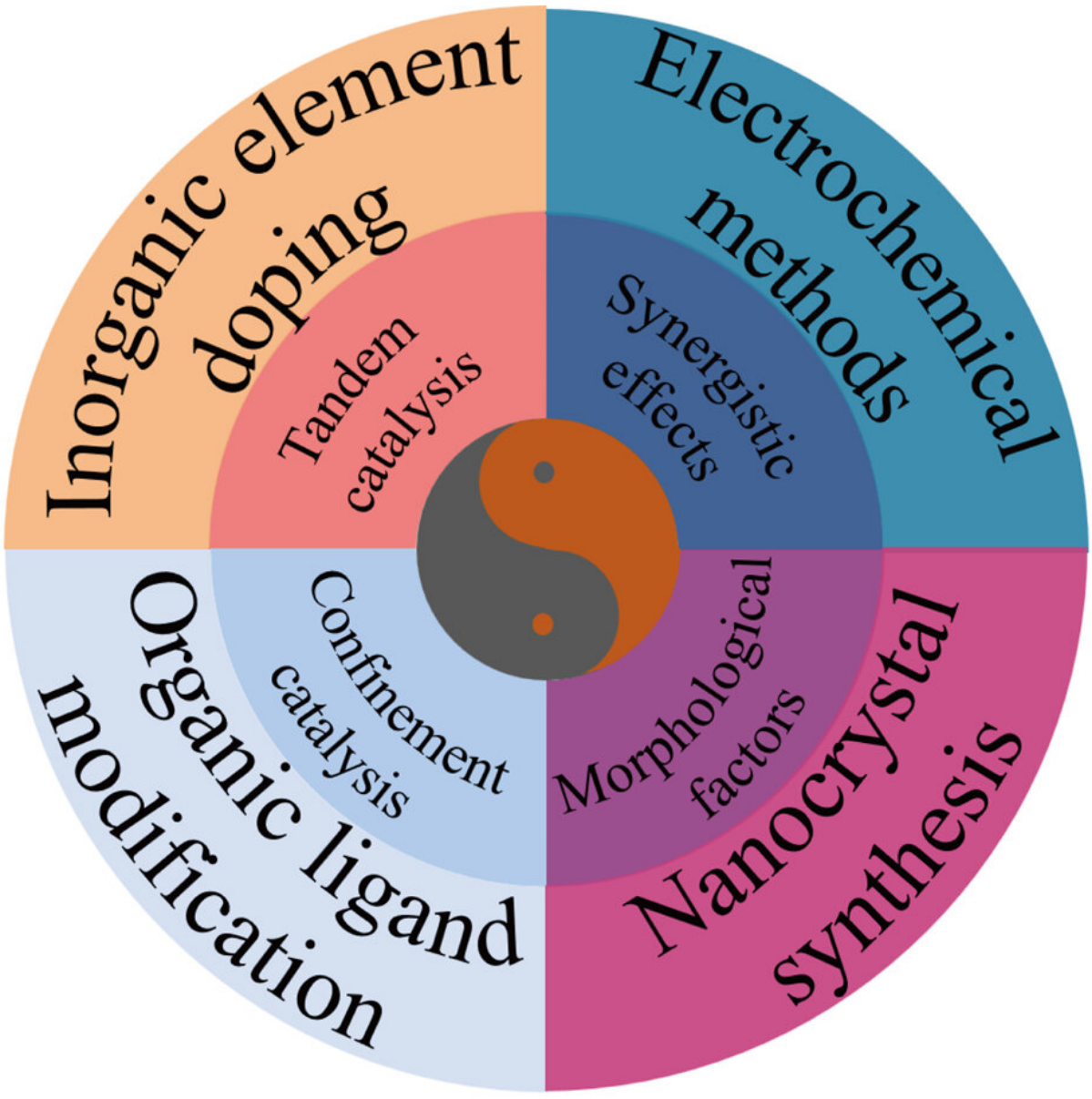

Different tuning strategies enable differences in catalyst structures. How to make a choice from these available tuning strategies? A trade-off can be made between the desired structure and performance of catalysts based on full knowledge of the advantages and disadvantages of a specific tuning strategy. Credit: Chinese Journal of Catalysis

Excessive carbon dioxide emissions from fossil fuel consumption lead to serious climate and environmental problems, such as increasing global average temperature and sea-level rise. The crucial link is diminishing greenhouse gas (mainly CO_2) concentrations in the air, which requires efficient CO_2 conversions and utilizations. Electrocatalytic reduction reaction of carbon dioxide (CO_2RR) can directly convert renewable electricity and CO_2 into valuable chemicals, such as formic acid, methanol and ethanol.

Because of the multi-electron reaction mechanisms, the CO_2RR products are varied, so the catalyst design is crucial. Substantial strategies have been devoted to searching CO_2RR catalysts for specific products. The catalysts with different components or the different intrinsic structure with the same component can both invoke distinct performance. Therefore, reasonable strategies for tuning the intrinsic and external structure of catalysts have become a primary concern. It is important to develop new strategies for preparing CO_2RR catalysts, while the crystal plane, defect, vacancy or multi-component factors in the structure may lead to a series of effects to improve the catalytic activity. The analysis of the activity sources of different catalysts can reveal the catalytic intrinsic nature, which can provide theoretical support for designing CO_2RR catalysts.

Recently, a research team led by Prof. Weilin Xu from Changchun Institute of Applied Chemistry, Chinese Academy of Sciences reviewed the tuning strategies and structure effects of catalysts for the electrocatalytic CO_2 reduction reaction. The catalyst tuning strategies were reviewed from intrinsic (electrochemical methods, nanocrystal synthesis) and external (inorganic element doping, organic ligand modification) perspectives, respectively. The structure effects for the CO_2RR catalysts have also been discussed, such as tandem catalysis, synergistic effects and confinement catalysis. This review about tuning strategies and structure effects can provide guidance for designing highly efficient CO_2RR electrocatalysts. This review paper was published in *Chinese Journal of Catalysis*.

More information: Cong Liu et al, Tuning strategies and structure effects of electrocatalysts for carbon dioxide reduction reaction, *Chinese Journal of Catalysis* (2022). DOI: 10.1016/S1872-2067(21)63965-7