Origin and effect of surface oxygen-containing species on electrochemical carbon/oxygen reduction reactions

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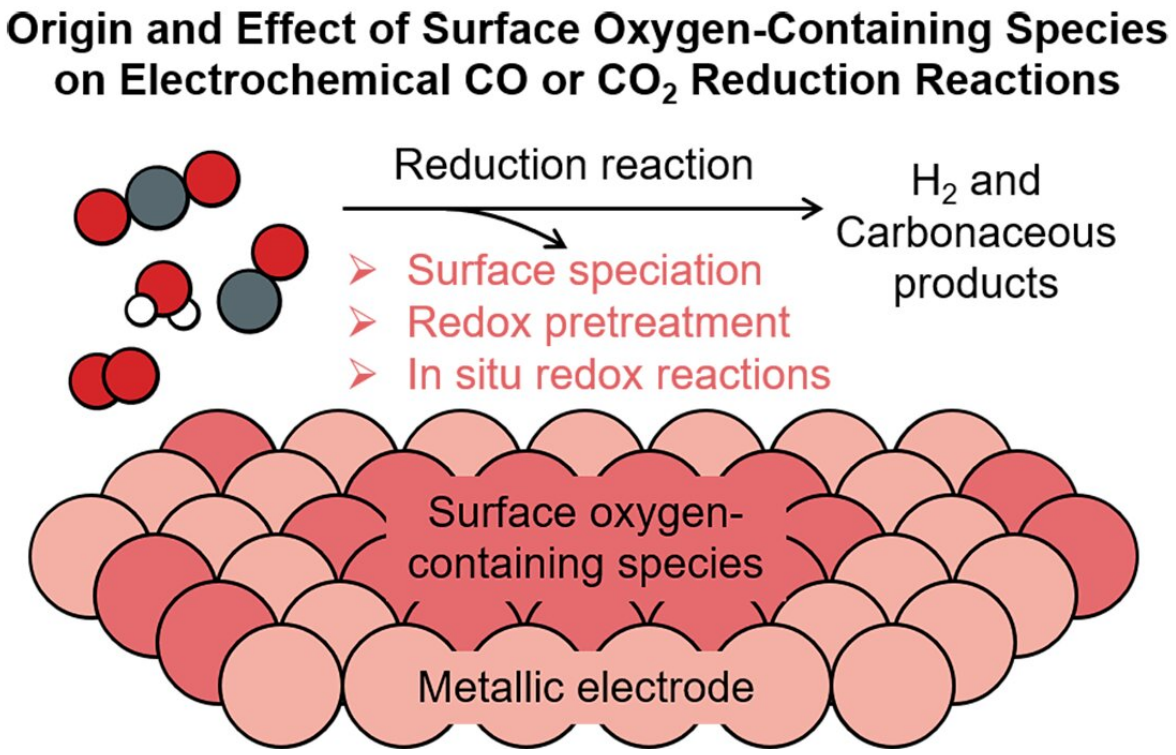

Origin and effect of surface oxygen-containing species on electrochemical CO or CO_2 reduction reactions. Credit: Science China Press

Renewable-energy-powered electrochemical CO or CO_2 reduction reactions ($CO_{(2)}RR$) is one of the most promising strategies to upgrade

CO_2 to valuable products. A key question and bone of contention is whether any surface or subsurface oxygen remains on the electrocatalysts under the reducing $CO_{(2)}RR$ conditions, and if so, whether that oxygen play any role in facilitating the reaction.

Thermodynamically, the oxides are expected to be reduced to the metallic form under the $CO_{(2)}RR$ conditions according to the Pourbaix diagram. However, multiple experimental studies report evidence for oxygen-containing species on electrocatalysts at $CO_{(2)}RR$ conditions, which could be attributed either to the difference in reaction and characterization conditions, or to the distinct thermodynamic stabilities of surface and bulk oxides.

This mini-review led by Prof. Bingjun Xu (College of Chemistry and Molecular Engineering, Peking University) summarizes recent literature on this topic and discusses the possible sources of oxygen-containing species at or near the electrode-electrolyte interfaces under $CO_{(2)}RR$ conditions.

Potential (sub)surface oxygen-containing species are grouped into three main categories based on the conditions at which they are introduced: (1) via the exposure to ambient air; (2) via the pretreatment of the catalyst; and (3) with the assistance of additional oxygen sources via in-situ redox reactions.

Potential impact of oxygen-containing species on the activity and product distribution in the $CO_{(2)}RR$, and the perspectives on future efforts to reveal the identity and role of oxygen-containing species in the $CO_{(2)}RR$ are also discussed.

The findings are published in the journal *Science China Chemistry*.

More information: Xiaoxia Chang et al, Origin and effect of surface

oxygen-containing species on electrochemical CO or CO_2 reduction reactions, *Science China Chemistry* (2022). DOI: 10.1007/s11426-022-1459-3