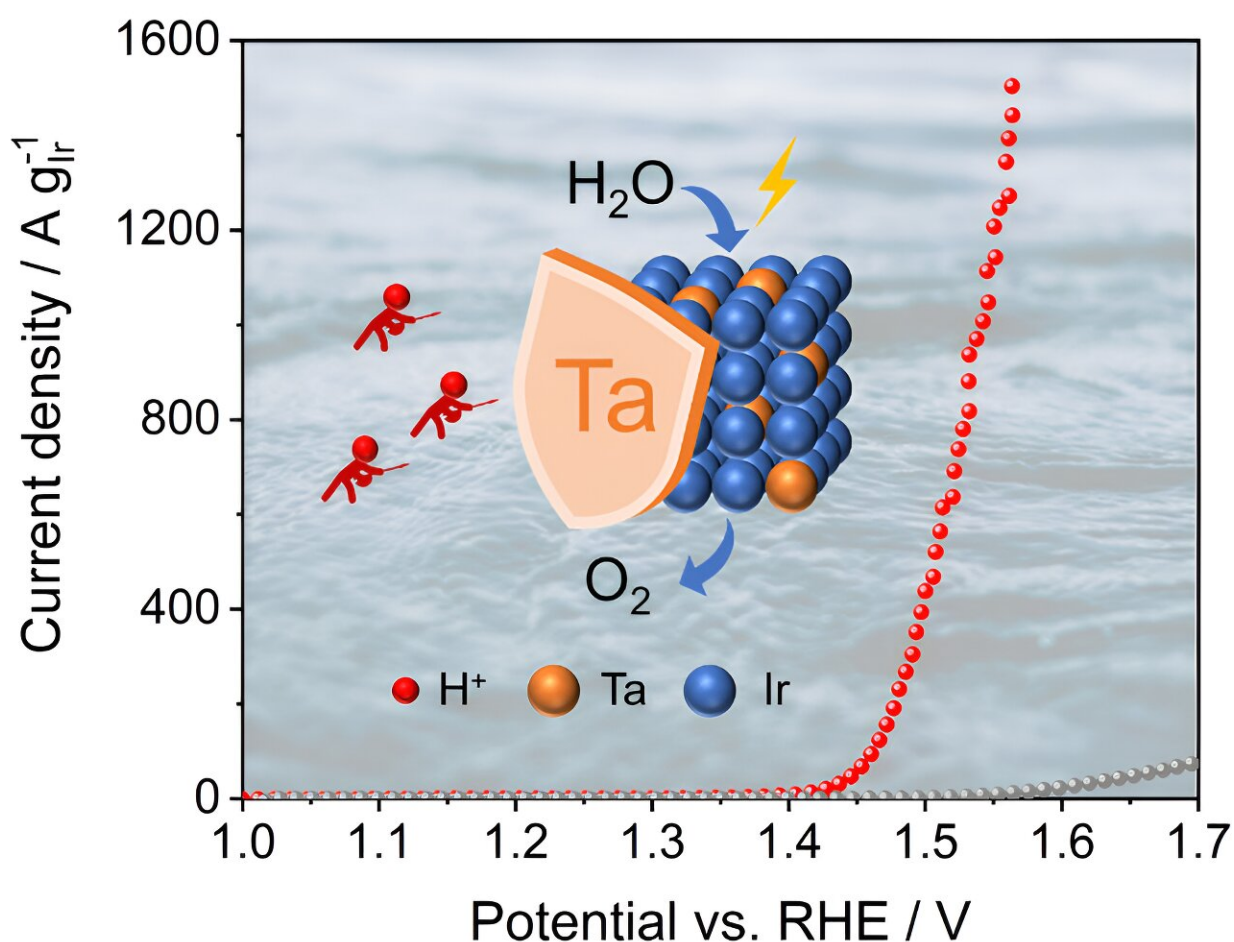


High-valence metal-doped amorphous IrO_x as stable electrocatalyst for acidic oxygen evolution reaction

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Using a one-step sintering method, researchers introduced high-valence metal doping and defect engineering to construct the amorphous iridium oxide. This strategy reduced the energy barrier of the rate-determining step on IrO_2 , and promoted the stabilization of the local structure, resulting in the simultaneously

enhanced activity and durability for OER in acidic media. Credit: *Chinese Journal of Catalysis* (2023). DOI: 10.1016/S1872-2067(23)64517-6

Hydrogen has been regarded as a potential energy carrier instead of fossil fuels, addressing energy demand and environmental issues. Proton exchange membrane water electrolysis (PEMWE), with its high energy density, elevated hydrogen purity, and rapid system response, is considered an ideal and sustainable approach to produce green hydrogen. Thus, it could be an effective solution to mitigate the intermittency and volatility of renewable energies and benefit their large-scale application.

However, the anodic oxygen evolution reaction (OER) in PEMWE involves a slow four-electron/proton transfer process, resulting in slow reaction kinetics. In addition, the localized strong oxidative and acidic environment will corrode the catalyst, leading to poor durability. Therefore, there is an urgent need to develop efficient and stable OER catalysts to boost the OER toward high-efficiency and economic hydrogen production via water splitting.

Recently, Prof. Xinbo Zhang from Changchun Institute of Applied Chemistry, Chinese Academy of Science, and collaborators have developed a series of high-valence metal-doped amorphous iridium electrocatalysts through one-step sintering for promoting the OER in acidic media. Benefiting from the modulation of geometric and electronic effects by the introduction of Ta doping and defect engineering, the enhancement of both activity and stability compared to the commercial IrO_2 and IrO_x was realized.

The results were [published](#) in the *Chinese Journal of Catalysis*.

High-valent metal doping was achieved through a straightforward one-

step sintering process, wherein the construction of defects was controlled by adjusting the reaction temperature. The introduction of dopants and defects is advantageous in facilitating the charge transfer, augmenting reaction sites, and enhancing the intrinsic reactivity of OER on IrO_x. Simultaneously, the robust interaction of metal (Ta)-oxygen coordination further enhances the stability of IrO_x during the reaction.

The optimal electrocatalyst (350-Ta@IrO_x) exhibits 147.7 times higher mass activity (1207.4 A g_{Ir}⁻¹) than that of commercial IrO₂ at 1.55 V vs. RHE. Combined with the theoretical calculations, it was disclosed that Ta doping and defect engineering are conducive to the nucleophilic attack of water molecules of the rate-determining step, thereby enhancing catalytic activity and reducing the overpotential of OER on IrO_x.

In addition, it demonstrates no noticeable performance degradation during the 500 h durability test, obviously outperforming the undoped sample and commercial IrO₂ and claiming its potential for industrial applications.

More information: Ning Zhang et al, High-valence metal-doped amorphous IrO as active and stable electrocatalyst for acidic oxygen evolution reaction, *Chinese Journal of Catalysis* (2023). [DOI: 10.1016/S1872-2067\(23\)64517-6](https://doi.org/10.1016/S1872-2067(23)64517-6)

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