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Stability challenges of iridium-based oxides towards acidic water splitting – Structure matters!

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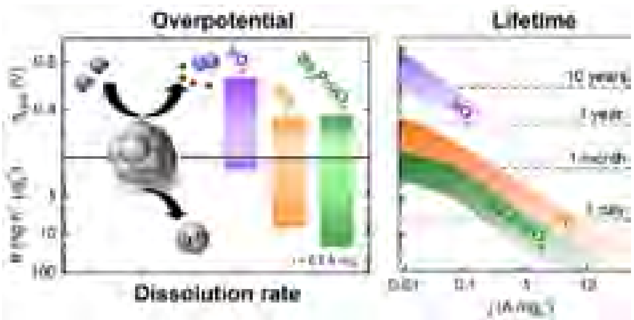
Reduction of noble metal loading and increase of specific activity are omnipresent challenges for oxygen evolution catalysts in proton exchange membrane (PEM) water electrolysis. The latter are often tackled by using iridium oxides with amorphous or perovskite structure with less focus on their stability during operation. In this presentation degradation processes of various iridium-based perovskites in relation to amorphous and crystalline iridium oxide are explored: Leaching of the non-noble elements in perovskites will lead to formation of amorphous iridium oxide, which is very active towards oxygen evolution but does not fulfill stability requirements. Crystalline IrO2, on the other hand, resists the harsh operational OER conditions to a great extent; however, higher potentials have to be applied to reach the same current density. Combination of data on activity, dissolution, and structure are summarized in a conclusive dissolution pathway which is correlated with OER mechanisms. The instability of amorphous structures is explained by participation of activated oxygen atoms, generating short-lived vacancies that favor dissolution. These insights are considered to guide further research which should be devoted to increasing utilization of pure crystalline iridium oxide, as it is the only known structure that guarantees lifetimes ≥10 years in acidic conditions. In case amorphous iridium oxides are used, solutions for stabilization are needed.



Biography

Simon Geiger has his expertise in stability evaluation of electrocatalysts for the oxygen evolution and oxygen reduction reaction. He studied Chemical Engineering and Chemistry at the Applied University of Mannheim and University of Stuttgart, before he joined the Electrocatalysis Group of Karl J J Mayrhofer at the Max Planck Institute for Iron Research, Germany, where he is currently working on his PhD thesis.

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