

Ru and Ir Synergy in Oxygen Evolution in Acid Media

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Anodic oxygen evolution is one of the cornerstone reactions supporting storage of renewable energy. The oxygen evolution represents the kinetically limiting process controlling the viability of the water electrolysis proposed to generate energetically useful hydrogen possibly replacing fossil fuels. One of the biggest obstacles in large scale deployment of hydrogen technologies is the scarcity of the state of the art oxygen evolving catalysts – namely of those based on Ir. The avoidance of the need for Ir in oxygen evolution electrocatalysis represents one of the central tasks in electrocatalytic research. There are so far two principal approaches one may employ in this effort - one can either achieve a better utilization of the available Ir in the electrolyzers by anode engineering or one can develop novel electrode materials minimizing the Ir content while maintaining sufficiently high activity.

One of the most promising novel catalytic systems which may possibly decrease the need for Ir in acid water electrolyzer is the use of high entropy materials [1]. The theoretical analysis of the high entropy oxides for OER, however, indicates that despite the rich possibilities to fine tune catalytic behavior of the complex oxides containing 5 or more transition metals the overall activity improvement rests essentially a combination of Ru and Ir in the complex oxides. Presented paper will demonstrate the potential of synergetic effects encountered in mixed Ru-Ir oxides on examples of Ru and Ir pyrochlores [2] and of binary Ru-Ir-O oxides with rutile structure. The superior electrocatalytic activity of the Ru-Ir oxides will be related to local structure of the prepared phases based on ex-situ X-ray absorption spectroscopy. The nature of the actual synergy encountered in these systems will be further demonstrated on the operando O-K edge X-ray absorption spectra.

[1] K.L. Svane, J. Rossmeisl, *Angew. Chem. Int. Ed.*, 2022, 61, e202201146. [2] R.K. Pittkowski, D.F. Abbott, R. Nebel, S. Divanis, E. Fabbri, I. E. Castelli, T.J. Schmidt, J. Rossmeisl, P. Krtil, *Electrochim. Acta*, 2021, 366, 137327