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Comparing the Kinetic Activation Energy of the Oxygen Evolution and Reduction Reactions

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Abstract

The reduction of the activation or kinetic overpotential for the oxygen evolution and reduction reactions (OER/ORR) is of central significance to optimize conversion efficiency of polymer electrolyte water electrolysis and fuel cells (PEWE/PEFC). In both cases increasing temperature seems to be an option. In this work, similarities and differences of temperature-dependence of the kinetic overpotential of the oxygen evolution and reduction reactions are investigated. While both overpotentials decrease with temperature, only in PEWE a significant cell performance gain is obtained at relevant current densities due to the decreasing reversible thermodynamic cell voltage with temperature. Furthermore, for both reactions, the corresponding activation energies at constant overpotentials and constant cell voltages are determined according to the Butler-Volmer equation and transition state theory. At constant overpotentials a similar decrease in the activation energy from equilibrium conditions (approx. 67 kJ/mol) to an overpotential of about 0.3 V (approx. 40 kJ/mol) is

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