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Separation of kinetic and mass transport effects in the electrolysis of formic acid in a flow-through cell

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Abstract

The effects of mass transport and kinetics have been separated by analysis of the flow rate dependence of the current for formic acid oxidation at fuel cell electrodes in a flow-through cell. The mass transport limiting current was reached when a carbon supported Pd catalyst was used, which allowed the power of the flow rate dependence to be determined. Simulation of the flow rate dependence of the current in the mixed kinetic-mass transport region then allowed the electron transfer rate constant and kinetic current to be determined as a function of potential. Comparison of Tafel plots for the Pd electrode and a Pt black electrode demonstrated that the superior activity of Pd was primarily due to its lower Tafel slope. The flow-through cell geometry allows measurements to be made on fuel cell electrodes at high current densities, and provides kinetic parameters that are not influenced by diffusion of the reactant into the catalyst layer.

Keywords: Flow cell; formic acid; electrocatalysis; Tafel; mass transport; kinetics

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