ELECTROCATALYTIC ACTIVITY AND FUEL CELL PERFORMANCE OF Pd/PVF⁺ CATALYST SYSTEM TOWARDS FORMIC ACID OXIDATION

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Key Words: Poly(vinylferrocenium), Fuel Cell, Pd particles, Formic Acid Oxidation

The use formic acid as a fuel has received growing interest during the last years as it proves to be easy to handle, of higher cell voltage, of high energy and power density as well as of low fuel crossover [1]. Pd-based catalysts are known to produce high performance in direct formic acid fuel cells (DFAFCs). Pd not only exhibits high catalytic activity for formic acid oxidation, but also overcomes the CO poisoning effect [2].

The use of functional polymers as support materials for metal particles greatly influences the catalytic properties of the metal. Firstly, the polymer support allows the generation of metal particles with a controlled size and size distribution. Secondly, it provides a mean to influence the chemical behavior of the metal particles through the direct interaction of the metal surface with the polymer-bound functional groups. Having the advantages of simple electrochemistry, high stability and ease of preparation, poly(vinylferrocene) (PVF) has been widely used as a fundamental conducting polymer system. Poly(vinylferrocenium) (PVF⁺) coated electrodes can be easily prepared by the constant potential anodic electrolysis of methylene chloride solution of the polymer, which results in a polymer coating containing both ferrocene and ferrocenium forms of the polymer. Besides being positively charged, the polymer matrix is in a porous structure allowing it to be useful in many applications [3].

The present study summarizes the use of PVF⁺-supported Pd particles for electrooxidation of formic acid. The metal particles were electrochemically obtained from aqueous solution of K₂PdCl₄ by cyclic voltammetric scans between +1.0 V and -0.8 V vs. saturated calomel electrode (SCE). The Pd/PVF⁺ catalyst system showed catalytic activity towards formic acid oxidation. The system was also tested as anode material in a home made single fuel cell configuration at ambient temperature and atmospheric pressure. An open circuit voltage of 385 mV was obtained from the DFAFC using 6 M formic acid solution containing 0.5 M H₂SO₄ as the fuel. Maximum power density was calculated as 0.48177 mW cm⁻² at 3.03 mA cm⁻².

References