

INFLUENCE OF THE TEMPERATURE AND ELECTROLYTE CONCENTRATION ON AN HYDROGEN/AIR FUEL CELL

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SUMMARY

The influence of the temperature and the electrolyte concentration on an alkaline Fuel Cell has been studied through the variation of the current density and the potential of the cell. As anode has been utilized a palladium membrane and as cathode, a carbon-tetrafluoroethylene-perovskite porous electrode. The electrolyte used is aqueous KOH.

Key words: Alkaline Fuel Cell, palladium

INTRODUCTION

An alkaline fuel cell (AFC) is an electrochemical device that converts the chemical energy of a fuel (hydrogen) and an oxidant (air or oxygen) in electrical energy, employing an alkaline electrolyte. An AFC usually operates at a low temperature level no higher than 80°C.¹

The best performance of AFC systems was achieved by the use of porous PTFE-bonded electrodes with high noble metal loadings. AFC systems were developed for space applications with no cost limitations. The employment of AFC's for terrestrial applications have the necessity to minimize the system cost.²

In order to achieve this cost minimization, it is necessary to decrease the noble metal load used as catalyst or to utilize other kinds of electrodes. On the other hand, with the aim to avoid the poisoning of the catalyst, pure reagents are employed. This fact put up the price of the system.

The work that is carrying out in our laboratory try to develop an alkaline fuel cell with a palladium membrane as anode. The palladium is a metal that shows the property to be a selective membrane to the hydrogen.³ It is used in order to be able to utilize a gas mixture or impure hydrogen obtained as by-product from different industrial processes.

EXPERIMENTAL PART

The experiments were realized in a one-compartment cylindrical cell. The electrodes were placed each at the bottom of a cylindrical holder of Teflon and immersed into the solution. The solution was aqueous KOH (Merck, analytical grade). The gases, air or hydrogen, are supplied to the electrode through a coaxial glass tube. A copper wire joined to a spring was used as electrical contact with the electrodes.

The anode was a palladium membrane with 0,025 mm thickness and a diameter of 13 mm supplied by Goodfellow. The cathode was a porous electrode composed of carbon Teflon and perovskites on a Nickel mesh from Goodfellow. The carbon employed for the electrode was a Printex L Carbon from Degussa and the Teflon one was a 60%weight dispersion provided by Du Pont de Nemours. The perovskite-type oxides were synthesized according to Zhang et al.⁴ The cathode was prepared at the similar way to those made by Brillas et al.⁵ The surface of the electrodes that was in contact with the electrolyte was 1 cm². To obtain the current and potential measurement, a resistance of 100Ω was inserted in the external electric circuit. As reference electrode was used a Hg/HgO electrode.

RESULTS AND DISCUSSION

The figure 1 shows the evolution of the current density when the cell works with a electrolyte concentration of KOH 5M and at different temperatures using a 100 Ω resistance in the external circuit. In the first seconds, the current density reaches a maximum that is due to the accumulated gases in the interface electrode-electrolyte. Immediately after the current density decreases until arrives to the stationary state.

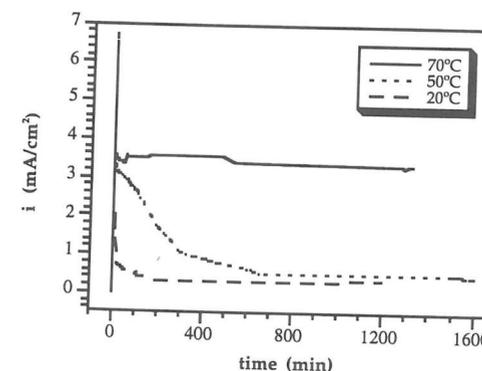


Figure 1: Evolution of the current density with an electrolyte concentration of KOH 5M and at different temperatures: 20, 50 and 70°C. The electrodes are Pd and CTP. Reagents: hydrogen and air.

On the other hand current density increasing is showed when the temperature increases. This effect is more important when the temperature goes from 50 to 70 °C than when it goes from 20 to 50°C.

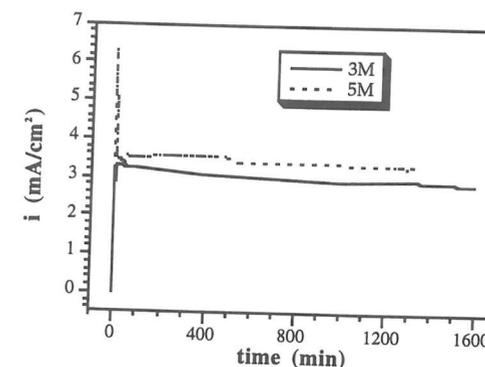


Figure 2: Evolution of the current density when the cell works at 70°C with different concentrations of electrolyte: KOH 3 and 5M. The electrodes are Pd and CTP. Reagents: hydrogen and air.

The influence of the electrolyte concentration in the current density of the fuel cell is showed on the figure 2. The stationary current density is greater when the electrolyte concentration increases.

| [KOH] | T ^a /°C | E ⁰ _{an} /mV | E ⁰ _{cat} /mV | E _{an (st.)} /mV | E _{cat (st.)} /mV |
|-------|--------------------|----------------------------------|-----------------------------------|------------------------------|-------------------------------|
| 5M | 20 | -878 | 50 | -45 | -11 |
| 5M | 50 | -904 | 103 | -70 | -20 |
| 5M | 70 | -921 | 57 | -427 | -95 |
| 3M | 70 | -874 | 70 | -365 | -77 |

Table 1: Anode and cathode potentials for different temperature and electrolyte concentration. E⁰ is the equilibrium potential

Table 1 shows the potentials of the electrodes at open circuit (E⁰) and at the stationary state (st.), with the different work conditions

The effect of the temperature is greater in the anode than in the cathode.

ACKNOWLEDGMENTS

This work has been supported by the Fundación Domingo Martínez and Carbueros Metálicos S.A.

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"IN-SITU" SPECTROELECTROCHEMICAL STUDIES OF A POLYPYRROLE/POLYVINYLSULPHONATE COMPOSITE.

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SUMMARY

In this work an UV-vis spectrophotometer technique adapted to "in-situ" absorption-reflection experiments is presented. Visible spectra at different oxidation potentials for Polypyrrole/Polyvinylsulphonate composite controlled in 0.1 M LiClO₄ water solution were performed. The evolution of the visible-absorption spectra in the oxidized and reduced states as a function of the number of cycles of the coloration/decoloration was followed.

Keywords: "in-situ" absorption-reflection, polypyrrole/polyvinylsulphonate, stability.

1. INTRODUCTION

The simultaneous oxidation-polymerization processes during the electrogeneration of conducting polymers in presence of polyelectrolytes, promote the participation of the polyanion in the polymer film required to compensate the positive charges generated along the chains of the growing conducting molecules. A conducting polymer/polyelectrolyte composite has an open structure due to the great free volume of the polyanion. This great