MEASURING ELECTROCHEMICAL OXYGEN REDUCTION ACTIVITY AT THE PT-NAFION INTERFACE USING A SOLID STATE OXYGEN-OXYGEN CELL

Henrik Ekström [a], Dan Lindström [a], Per Hanarp [b], Erik Fridell [b], Göran Lindbergh [a] and Anders Lundblad [a]

a) Department of Chemical Engineering and Technology, Applied Electrochemistry, The Royal Institute of Technology, Stockholm SE-100 44, Sweden

b) Competence Centre for Catalysis, SE-412 96 Göteborg, Sweden

INTRODUCTION

The normal procedure for measuring the electro-chemical catalytic activity of a catalyst surface is using a three-electrode cell and a liquid electrolyte. If one wishes to screen suitable future polymer electrolyte fuel cell catalysts the above system might not be suitable, since the electrolyte is different. Important characteristics of the behaviour in a final fuel cell application might thus not be seen. It is therefore desirable, when investigating catalysts for PEFC, to develop methods for measuring catalytic activity at the catalyst-polymer electrolyte interface.

Our aim is to use the newly developed electrochemical cell to screen suitable future nano-designed fuel cell catalysts for the PEFC.

EXPERIMENTAL

The working electrode was fabricated by coating a 6 mm ∅ glassy carbon substrate with a 20 nm thermally evaporated platinum film (roughness < 1 nm). A thin film of Nafion (≈300 nm) was then spin-coated on top of the catalyst surface. The sample was mounted in the measurement cell shown in Figure 1.

The porous counter electrode and the reference electrode were made by paint brushing electrode ink onto a Nafion 1025 membrane. The ink consisted of PtRu(1:1, 40 %) on Vulcan from E-TEK and Nafion solution from DuPont. The Nafion content of the electrodes was around 40%.

A slow polarisation plot of the cathode potential versus NHE was recorded using a PAR 263A potentiostat. The cell temperature was 60°C. The inlet gases where humidified at 55°C.

RESULTS

A recorded polarisation plot with both the measured current i and the calculated kinetic current i_{kin} is shown in Figure 2 (The kinetic current was calculated from the expression $1/i = 1/i_{lim} + 1/i_{kin.}$).

The limiting current $i_{lim} = 10^{-3.6} = 233\mu A/cm^2$, is quite low, something that results in a narrow potential window.

The mass transport of oxygen may be improved by using a thinner membrane or possibly replace the membrane with a porous solid electrolyte layer.

Future experiments will investigate the oxygen reduction activity of various nano-fabricated catalyst surfaces made by colloidal lithography.

ACKNOWLEDGEMENTS

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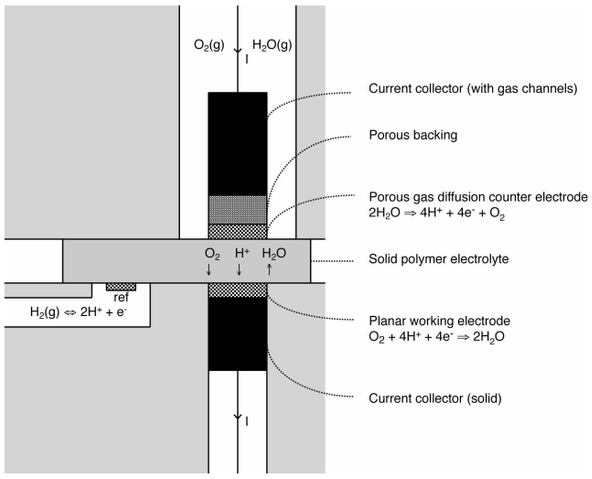

Figure 1. Conceptual drawing of the measurement cell (Not to scale).

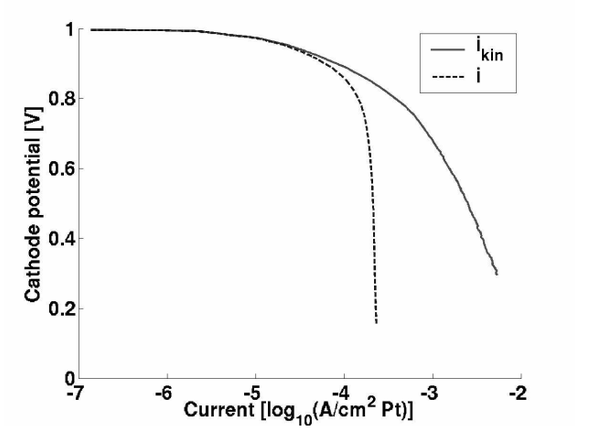

Figure 2. Steady state polarisation curve.