Oxygen Reduction Reaction at Nafion Film-Coated Carbon Supported

Platinum Electrode: Transport and Kinetics

M. R. Reda

CanadElectrochim,

Calgary, AB, Canada (corrosion555@hotmail.com)

Mass transfer resistance can control many very important electrochemical reaction such oxygen reduction reaction, ORR, at the cathode of fuel cell .ORR is industrially important electrochemical reaction which is applied to fuel cell, metal air batteries and air depolarized cathodes [1]. However it is important to study the electrochemical reaction (kinetic current density i_k at the electrode surface) without any interference from mass transfer resistance. The usual procedure done by many investigators is the use Levich–Koutecky-type analysis which is valid when both activation i_k and concentration (diffusion current density i_d) polarization are controlling the electrochemical reaction[2]. The first part of this work was applied to the case where the mass transfer resistance through a Nafion film (electrolyte of fuel cell) is negligible. In this part the purpose is to show the non-validity of Levich–Koutecky analysis of the type

$\frac{1}{i} = \frac{1}{i_k} + \frac{1}{i_d} + \frac{1}{i_f}$, when applied to an electrode covered with Nafion film and the diffusion resistance in this Nafion film is not negligible. This equation was first proposed by Lawson and co-workers[3] for a carbon supported platinum electrode which was covered with Nafion film and i_f is the current density through the Nafion film. Furthermore, it will be shown that the assumption of the existence of more than one limiting current density is not correct and that only one limiting current density may exist for any electrode. A simple equation is derived for the mass corrected kinetic current i_k.

(1) Chang and coworkers, Electrochimica Acta, 42, 4, 557 (1997).
(2) Jo and Shanmugam, Electrochemistry Comm. In press Aug 2012.
(3) Lawson and coworkers J. Etectrochem. Soc. 135, 9, 2248 (1988).