The present work closely examines Zr based nano structured conversion coat for laboratory tests. Corrosion and adhesion studies are carried out on test panels, which are coated in different conditions such as different composition and contact time. Tests are conducted on hot rolled steel (HRS) and hot rolled steel pickled (HRS-P). Some of the HRS test panels are shot blasted prior to pre-treatment process. Furthermore, surface morphology of nano structured coating is examined by using SEM and XPS. Corrosion study carried out by using Electrochemical Impedance Spectroscopy (EIS) and Neutral Salt Spray (NSS) test by following ASTM B117. Adhesion tests are performed as cross hatch test, impact test, bend test (conical mandrel). Preliminary results showed that nano structured conversion coat has advantage to conventional conversion coating such as iron phosphate (FeP). Also, correlations between conventional conversion coatings and new nano structured conversion coats are discovered and will be reported in the paper.

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Prof. A.M.F.R Pinto

Direct Methanol Fuel Cells operating at high methanol concentrations: modelling and experimental studies

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Within the last years, there has been an increased interest in direct methanol fuel cells (DMFCs) as they are a promising power source for micro and portable applications since methanol is liquid at room temperature, has high energy density, is easy to handle, and easy to storage and distribute. Although, a number of issues need to be solved before DMFC can be commercially viable. These include the slow anode kinetics arising from a multi-step fuel oxidation process at the anode which results in higher anodic overpotentials, and the fuel crossover from anode to cathode. The crossover not only lowers the fuel utilization, but also degrades the cathode performance and generates extra heat. Therefore, optimizing design and operating condition are critical in improving the DMFC performances. Some studies revealed that optimised operating conditions are elevated cell temperatures to improve the anode reaction, high air stoichiometries to prevent cathode flooding and dilute methanol solutions to mitigate methanol crossover. Although more concentrated methanol solutions would be preferable in order to achieve energy densities needed for portable power applications, the use of concentrated methanol solutions at the anode is limited by the significant increase of methanol crossover flux with methanol concentration. So, low methanol crossover in a DMFC is essential for using high concentration methanol in portable power applications.
In the present work, a detailed experimental study on the performance of an «in-house» developed DMFC with 25cm^2 of active membrane area, working near the ambient conditions (ambient pressure and temperature) at high methanol concentrations is described. Tailored MEAS (membrane electrode assemblies) and different structures and combinations of gas diffusion layers (GDL) were tested in order to select optimal working conditions at high methanol concentration levels without sacrificing performance. The experimental polarization curves were

successfully compared with the predictions of a steady state, one-dimensional model accounting for coupled heat and mass transfer, along with the electrochemical reactions occurring in the DMFC recently developed by the same authors [1].

References

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Prof. K. Habib

Invited Talk

A.C.Impedance-emission spectroscopy of determining the electrochemical behavior of anodized aluminium in aqueous solutions

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In the present investigation, holographic interferometry was utilized for the first time to determine the rate change of the alternating current (A.C.) impedance of aluminium samples during the initial stage of anodization processes in aqueous solution without any physical contact. In fact, because the A.C. impedance values in this investigation, were obtained by holographic interferometry [1&2], electromagnetic method rather than electronic method, the abrupt rate change of the A.C. impedance was called A.C. impedance-emission spectroscopy. The anodization process (oxidation) of the aluminium samples was carried out chemically in different sulphuric acid concentrations (0.5-3.125 % H_2SO_4) at room temperature. In the mean time, the real-time holographic interferometry was used to determine the difference of the A.C. impedance of two subsequent values, dZ , as a function of the elapsed time of the experiment for the aluminium samples in 0. 5%, 1.0%, 1.5%, and 3.125% H_2SO_4 solutions. The A.C. impedance-emission spectra of the present investigation represent a detail picture of not only the rate change of the A.C. impedance throughout the anodization processes , but also, the spectra represent the rate change of the growth of the oxide films on the aluminium samples in different solutions. Consequently, holographic interferometric is found very useful for surface finish industries especially for monitoring the early stage of anodization processes of metals , in which the rate change of A.C. impedance of the aluminium samples can be determined in situ .

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