

Electrocatalytic oxidation of methanol on Ni modified glassy carbon electrode

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Introduction

The direct methanol fuel cells (DMFC) have recently received a good deal of attention in both mobile and stationary applications due to their advantages of low operating temperature ($<100\text{ }^{\circ}\text{C}$), easy transportation and storage of fuel, high-energy efficiency and fast start-up of fuel. The mechanism and kinetics of methanol oxidation have been studied under a wide range of conditions and on a variety of electrodes including Pt, binary and ternary alloys, modified electrodes, nano-composites and nickel. One approach to the development of DMFC is to use alkaline electrolyte which is based on the assumption that electro-catalysis is generally more facile and inexpensive in this medium[1]. The purpose of the present work is to study the electrochemical oxidation of methanol on a nickel modified glassy carbon electrode in a solution of 1 M NaOH.

Keywords: Nickel, Modified electrode, Electrocatalysis, Methanol, Glassy Carbon.

Experimental

Electrochemical studies were carried out in a conventional three electrode cell powered by an electrochemical system comprising of EG&G model 273 potentiostat/galvanostat. The system is run by a PC through M270 commercial softwares via a GPIB interface. A glassy carbon (GC) disk electrode, a Pt wire, and Ag/AgCl-Sat'd KCl were employed as working, counter and reference electrodes, respectively. All studies were carried out at $298\pm 2\text{ K}$. Films of nickel were formed on the GC surface by galvanostatic deposition.

Results and discussion

The nickel oxide film was formed electrochemically on electrodeposited nickel in a regime of cyclic voltammetry on a glassy carbon electrode and tested for electrooxidation of methanol in a solution of 1 M NaOH. Fig.1 shows cyclic voltammograms of GC/Ni electrode in 1M NaOH solution in the absence (1) and presence (2) of methanol 0.3M at a potential sweep rate of 10mVs^{-1} . The anodic charge increased with respect to that observed for the modified surface in the absence of methanol and it was followed by decreasing the cathodic charge. This suggests that the oxidation of methanol is being catalysed through mediated electron transfer across the nickel hydroxide layer comprising of nickel ions of various valence states.





Figure 1.

Under the CA regime the reaction followed a Cottrellian behaviour and the diffusion coefficient of methanol was found to be $2 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$.

References

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