

Promoter Effects of Rare Earth Ions on Electrocatalytic Oxidation of Methanol

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Abstract: The promoter effects of rare earth ions on the electrocatalytic oxidation of methanol at the Pt electrode were studied using the cyclic voltammetry and stable polarization techniques. It was found for the first time that Eu, Ho, Dy ions could accelerate the electrocatalytic oxidation of methanol at the Pt electrode, while Lu, Pr, Yb, Sm ions showed inhibitor effects.

Keywords: Rare earth, methanol, electrocatalytic oxidation.

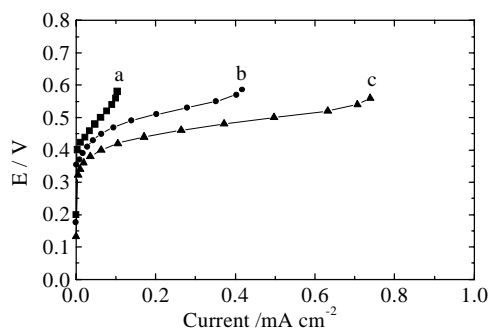
The low electrocatalytic activity of the Pt catalyst usually used has the disadvantage for the direct methanol fuel cell¹. Thus, a number of groups pay attention to find the active anode catalysts for promoting the oxidation of methanol. In this paper, it was found that some rare earth ions could promote the anodic oxidation reaction of methanol.

The electrochemical measurements were carried out with CHI potentiostat (CHI Co. U.S.A.) and traditional three-electrode cell. A Pt wire and saturated calomel electrode were used as the auxiliary and reference electrodes, respectively. The working electrode is the smooth Pt electrode. The apparent surface area of the Pt electrode is 0.03 cm². The electrolyte is 0.5 mol/L CH₃OH + 0.5 mol/L H₂SO₄ with or without the 0.1 mol/L rare earth ion. Usually, the electrochemical measurements were carried out at 25°C.

The cyclic voltammetric measurements showed that the potentials of the anodic peaks of the electrocatalytic oxidation of methanol at the Pt electrode in the electrolytes with and without rare earth ions are located at about 0.62 V. However, the peak currents in the electrolytes with the Eu, Ho or Dy ions are higher than that of without the rare earth ions, while the peak currents in the electrolytes with the Sm, Lu, Yb or Pr ions are lower than that of without the rare earth ions.

The measurements of the polarization curves indicated that the polarization performances of the electrocatalytic oxidation of methanol in the electrolyte with Ho, Eu or Dy ions are better than that of without the rare earth ions, while the polarization performances in the electrolyte with Sm, Lu, Yb or Pr ions are worse than that of without the rare earth ions. **Figure 1** shows the polarization curves of the electrocatalytic oxidation of methanol at the Pt electrode in the electrolytes with Pr (**Curve a**), Eu (**Curve c**) and without rare earth ions (**Curve b**).

Figure 1. The polarization curves of the Pt electrode in the 0.5 mol/L CH₃OH + 0.5 mol/L H₂SO₄ solution with (a) Pr, (c) Eu and (b) without rare earth ions



All the facts mentioned above indicated that the Eu, Ho and Dy ions in the electrolyte could accelerate the electrocatalytic oxidation of methanol at the Pt electrode and Sm, Lu, Yb and Pr showed the inhibitor effects. Further study is in progress.

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Reference

1. W. Mitchell, *Fuel Cells*, Academic Press, **1963**, 9.

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