Synthesis and Characterization of Pt-Ni and Pt-Ru alloy via the Single Source Precursor Route

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Introduction

For the past several years a great deal of work has been directed towards the development of CO tolerant Pt and Pt alloy catalysts for direct methanol fuel cell applications. Many binary, ternary and quaternary alloy systems have been explored and evaluated. While Pt-Ru catalysts are still considered as the most active binary catalyst, a few reports on Pt-Ni alloys and their advantages have surfaced in the immediate past. Single source precursor technique for the preparation of these alloy materials has been a consistent route to produce highly homogenous catalytic materials[1]. Here we report the synthesis and characterizations of carbon supported Pt-Ru and Pt-Ni alloys derived from single source precursors; and their electrochemical performance in room temperature oxidation of methanol.

Experimental

Single source precursors $[(bipy)_3Ni][PtCl_4]$ (**1**) and $[(bipy)_3Ru][PtCl_6]$ (**2**) (bipy = 2,2' bipyridine) were prepared by reacting $(bipy)_3NiCl_2$ with K_2PtCl_4 and $[(bipy)_3RuCl_2.6H_2O$ with H_2PtCl_6 respectively. Appropriate amounts of the precursors and VCX-carbon were ball milled and subjected to a heat treatment at 600°C under a H_2/Ar atmosphere. For the cyclic voltametric studies on the electrooxidation of methanol a 2M CH_3OH in 1M H_2SO_4 was used at a scan rate of 20 mV/sec.

Results and discussion

EDX analysis was used to determine the purity and the stoichiometric composition of the prepared alloy composites. It was found that the stoichiometric ratio of Pt to Ni or Ru was indeed 1:1, and the carbon support was devoid of halogen. SEM examinations showed that the alloy particles are well dispersed in the carbon support matrix (Fig 1). Preliminary cyclic voltammetric measurements using potential sweeps between 0 and 1V, detected the electrooxidation of methanol as a large anodic peak at around 680mV for carbon-supported PtNi alloy and at around 660 mV for carbon-supported PtRu.. The peak current densities of comparable sample size and metal loading (~20%) were 144 and 164 $\mu A/cm^2$ for PtNi and PtRu. A typical cyclic voltammograms are shown in Figure 2. Further data on material characterizations and electrochemical studies will be presented.

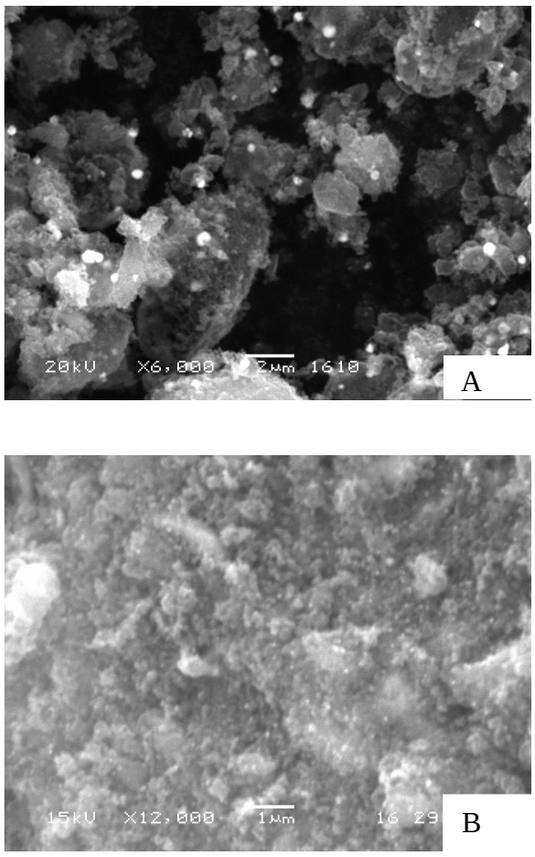

Fig.1 SEM image of carbon composites of (A) Pt-Ni alloy and (B) Pt-Ru alloy

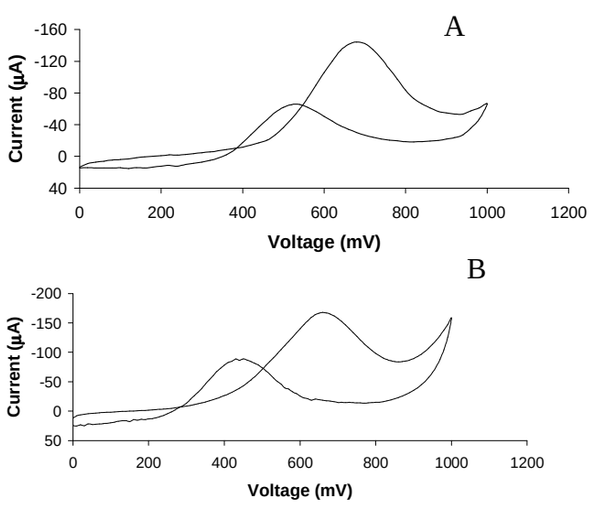

Fig.2 Cyclic voltammograms of (A) PtNi/C and (B) PtRu electrodes.

References:
1. D.L. Boxall, G.A. Deluga, E.A. Kenik, W. D. King, C.M. Lukehart, Chem. Mater., **13**, 891(2001).