

Performance of PdRu/C anode catalyst for anion-exchange membrane direct ethanol fuel cell

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In recent years there has been much efforts going into the development of highly active anode catalyst for anion-exchange membrane direct ethanol fuel cell (AEM-DEFC), and a variety of catalyst materials, including Pt, Pd, Rh, Ru, Au, Ni, etc., have been tested for ethanol oxidation reaction (EOR) in alkaline media. However, among the recently reported results, only the Pt based and Pd based catalysts showed promising activity in the potential range practical for fuel cell application. Pd is much cheaper and more abundant than Pt. Moreover, it has been reported that Pd showed higher activity and stability for EOR than Pt in alkaline media [1, 2]. Since the oxidation of ethanol in alkaline media is very complicated and involves many types of intermediates, such as  $C_1$  species (most likely  $CO_{ad}$  and  $CH_{x,ad}$ ),  $OH_{ad}$ ,  $CH_3CO_{ad}$  and other forms of acetaldehyde in alkaline media [2-4], single metal catalysts may not give the best performance for ethanol oxidation. Therefore, to further improve the activity and stability of the catalysts, substantial efforts have been devoted to modifying the Pd catalyst with a second metal M. Our previous reports [5] demonstrated that the  $Pd_xRu_y/C$  catalyst showed much higher activity toward EOR than the Pd/C catalyst and a ‘volcano’ behavior as a function of the Ru atomic ratio in the  $Pd_xRu_y/C$  catalysts for EOR was found in the cyclic voltametry (CV) and chronoamperometry (CA) tests. In this report, detail performance of the  $Pd_xRu_y/C$  catalysts as anode catalyst in AEM-DEFC is reported, which is agree well with both the CV and the CA test results. Also, the long-time constant current discharge of AEM-DEFC with different catalysts is demonstrated. The voltage of the AEM-DEFC using  $Pd_xRu_y/C$  catalyst as anode decreases with the discharge time. It is inferred that ruthenium in the  $Pd_xRu_y/C$  catalysts dissolute during the discharge of AEM-DEFC. For practice use in the AEM-DEFC, the stability of the  $Pd_xRu_y/C$  catalyst should be improved.

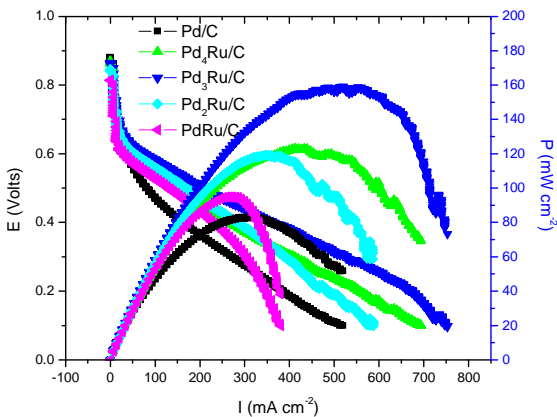


Fig. 1 Polarization and power density curves of the AEM-DEFC using various anode catalysts at 80 °C. Anode: 3 M EtOH + 1 M NaOH, 2 mL min<sup>-1</sup>; Cathode: dried oxygen, 300 sccm.

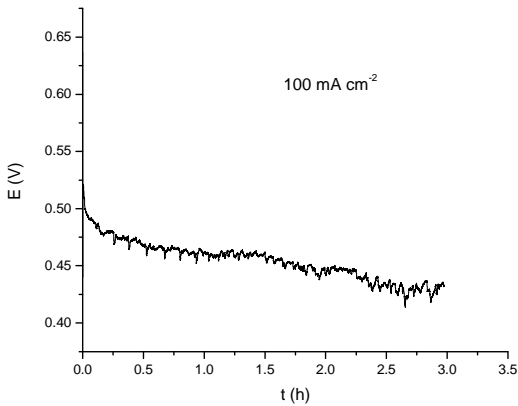


Fig. 2 Constant current discharge curves of the AEM-DEFC using  $Pd_3Ru/C$  as anode catalysts at 80 °C. Anode: 3 M EtOH + 1 M NaOH, 2 mL min<sup>-1</sup>; Cathode: dried oxygen, 300 sccm. Current density: 100 mA cm<sup>-2</sup>.

References

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