

PtSnCe/C and PtSn/C + Ce/C Electrocatalysts for Ethanol Oxidation Reaction

R.F.B. De Souza¹, J.C.M. Silva¹, M.H.M.T. Assumpção¹, A. O. Neto², M.C. Santos¹

¹ LEMN – CCNH - UFABC R. Santa Adélia 160, CEP 09210-170- Bangu - Santo André – SP -Brazil.

² IPEN-CNEN/SP, CCCH, Av. Prof. Lineu Prestes, 2242 – Cidade Universitária – 05508-900 São Paulo – SP - Brazil

rodrigo.souza@ufabc.edu.br

The electrocatalysts for ethanol oxidation reaction (EOR) are very attractive to the development of direct ethanol fuel cells. This alcohol is produced in large quantities from biomass and it is much less toxic than methanol. However, its complete oxidation remains a great challenge and the main products formed are acetaldehyde and/or acetic acid. PtSn/C [1] and PtSnCe/C [2] electrocatalysts prepared by polymeric precursors method were very active for EOR. In order to study a synergic effect of Sn and Ce with Pt for EOR this process was investigated using PtSnCe/C and PtSn/C+Ce/C electrocatalysts both with composition in mass ratios 68:22:10 (Pt:Sn:Ce), where the metal loading used were 20 % on carbon. The PtSnCe/C was prepared using the polymeric precursor method (PPM) [2]. PtSn/C+Ce/C was prepared by PPM and mechanically mixed to form the electrocatalyst. The catalytic activities towards ethanol oxidation for the different catalysts were evaluated by cyclic voltammetry and chronoamperometry. To gain some information about the intermediates and products of the reaction formed from ethanol electrooxidation, this process was investigated using “in situ” ATR-FTIR spectroscopy [3]. Among the catalysts investigated the PtSn/C+Ce/C is the best for ethanol oxidation. In this case, the current density measured by chronoamperometry for EOR in acidic media (HClO₄ 0.1 M + Ethanol 1 M) after 30 min at E = 0.5 V, (21 mA mg_{Pt}⁻¹) was 33% higher than that observed for PtSnCe/C (15 mA mg_{Pt}⁻¹) and about 91% higher than PtSn/C ETEK (11 mA mg_{Pt}⁻¹) for the same process. FTIR data showed that the observed behaviour may be explained by the favouring of the acetic acid pathway, whilst CO₂ showed a low level of formation for all catalysts.

Acknowledgments: UFABC, and FAPESP (Proc. Number. 09/09145-6, 10/16511-6, 10/07831-7, 10/04539-3).

[1] R.F.B. De Souza, L.S. Parreira, D.C. Rascio, J.C.M. Silva, E. Teixeira-Neto, M.L. Calegari, E.V. Spinace, A.O. Neto, M.C. Santos, J. Power Sources 195 (2010) 1589-1593.

[2] R.F.B. De Souza, L.S. Parreira, J.C.M. Silva, F.C. Simões, M.L. Calegari, M.J. Giz, G.A. Camara, A.O. Neto, M.C. Santos, Int. J. Hydrogen Energy. 36 (2011) 11519-11527.

[3] J.C.M. Silva, L.S. Parreira, R.F.B. De Souza, M.L. Calegari, E.V. Spinacé, A.O. Neto, M.C. Santos, Appl. Catal. B. 110 (2011) 141-147.