XXXVIII GE-RSEQ XIX EIB
XXXVIII REUNIÓN DEL GRUPO DE ELECTROQUÍMICA DE LA REAL SOCIEDAD ESPAÑOLA DE QUÍMICA
XIX ENCONTRO IBÉRICO DE ELECTROQUÍMICA
CIC energiGUNE energy cooperative research centre
05th -7th July 2017 Vitoria-Gasteiz, Spain

EC-FTIR studies for Ethanol electrooxidation in alkaline media with different catalysts

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Direct Alcohol Fuel cells (DAFCs) are Fuel Cells in which alcohol is used directly as fuel. Most studies DAFCs have been performed using methanol as fuel. However, the use of ethanol offers certain advantages as to the fact that ethanol obtained from renewable sources is less toxic and it has higher energy density than methanol[1]. Pt based catalysts are the most active ones for the electrooxidation of alcohols. However, the formation of intermediate species such as CO_{ad} results in the poisoning of Pt. In order to overcome this issue, PtM where M is an oxophilic metal such as Ru or Sn promotes the oxidation of such intermediate species. This strategy fails to promote the complete electro-oxidation of ethanol, because C-C bonds are difficult to activate at low temperatures. In order to improve the design of new catalysts it is necessary to identify the nature of adsorbed species during the ethanol oxidation reaction (EOR). One of the tactics for this end is the use of *in operando* spectroscopies, typically IRRAS (infrared reflection absorption spectroscopy). This technique has been widely used for the study of the electrooxidation of alcohols in acid media[2]. Despite the rising interest in alkaline fuel cells due to the faster kinetics for the electrooxidation of alcohols[3], *in operando* studies during the EOR in alkaline electrolyte are scarce. We have studied the EOR using *in operando* IRRAS with Pt/C, PtRu/C and Pt_3Sn/C catalysts in both H_2O (Fig. 1) and D_2O (not shown) alkaline electrolytes in order to identify properly the intermediate species overcoming the overlapping of vibrational bands of H_2O. Spectra (reported as the R/R_0 ratio) were acquired during positive sweep at $1mVs^{-1}$.

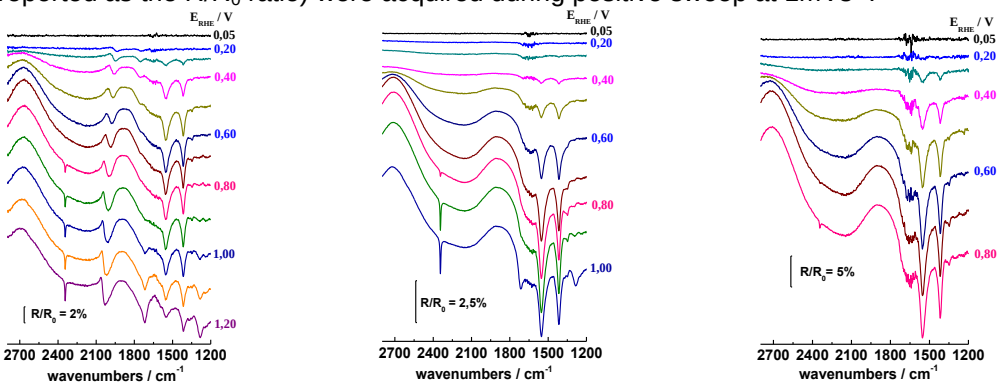

Figure 1. Selected IRRAS with a) Pt/C, b)PtRu/C and c) Pt_3Sn/C during EOR (0.5M CH_3CH_2OH) in 0.1M KOH/H_2O at $1mVs^{-1}$.

The spectra shown in Figure 1 demonstrate that the EOR proceeds by different pathways on each catalysts. Thus, at low potentials only Pt/C shows the formation of CO_{ad} (band at 2020 cm^{-1}) indicating the scission of the C-C bond. Acetates (bands at 1410 and 1550 cm^{-1}) are the most abundant species at high potentials.

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