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Reactivity of 3 carbon-atom chain alcohols on gold electrode: a comparison to understand the glycerol electro-oxidation

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Abstract

In this work, the electro-oxidation of glycerol was compared with those of similar 3 carbon-atom chain alcohols, namely 1-propanol, 2-propanol, propane-1,2-diol and propane-1,3-diol, in order to further understand the reactivity of glycerol on gold in alkaline environment. The corresponding products formation was monitored by *in situ* FTIR spectroscopy. The reactivity of the investigated alcohols on gold in alkaline medium decreased in the following order: glycerol > propane-1,2-diol >> propane-1,3-diol > 2-propanol ≈ 1-propanol. For glycerol and propane-1,2-diol, the products distribution provided by *in situ* FTIR spectroscopy showed indications of high C-C bond breaking rates, as evidenced by the presence of products with 1 and 2 carbon-atom chain. On the other hand, the electrochemical oxidation of propane-1,3-diol, 2-propanol and 1-propanol led only to products with 3 carbon-atom chain. Based on these evidences, it was stated that the presence of vicinal OH groups in the alcohol molecule may be a key feature for the C-C bond breaking in alkaline medium, leading to the generation of further oxidized products that, in turns, yield more electrons per alcohol molecule and consequently higher current densities. Additionally, electrochemical measurements were also performed in acidic and neutral media for comparison. Under these conditions, the alcohols exhibited much lower current densities compared to those in alkaline medium. This was explained by the lack of alkoxide formation (active species in alkaline medium) and the blockage of the surface by ClO_4^- anions.

Keywords

alcohol electro-oxidation, 1-propanol, 2-propanol, propane-1,2-diol, propane-1,3-diol, glycerol, gold electrode