Nonlinear phenomena during the electrochemical C-C bond scission of ethanol and ethylene glycol

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Low temperature fuel cells are probably the best alternative to internal combustion engines, from both performance and environment points-of-view. The direct use of ethanol in these devices is, however, severely compromised by its sluggish kinetics on most of platinum-based catalysts. In this context, one of the key-aspects is certainly the difficulties associated to the scission of the C-C bond. At low alcohol concentration and small overpotentials the C-C bond can be broken but resulting C1 products are only oxidized at high overpotentials. Moreover, under far from thermodynamic equilibrium conditions, it is possible to observe kinetics instabilities in the form of potential or current oscillations. The main goal of this work is to investigate the electro-oxidation of ethanol and ethylene glycol (EG) under oscillatory regime, in alkaline media and on platinum surfaces. Under potential controlled conditions, the electro-oxidation remains very low up to about 0.4 V (*vs* RHE). As the potential increases, EG shows higher activity than ethanol. When the current is kept constant oscillations developed in both systems but the frequencies are 200 times higher to system contenting EG. For ethanol oscillations develop between about 0.40 - 0.60 V, whereas for EG they occur between 0.50 - 0.80 V. The lower mean potential for ethanol oscillations shows that this alcohol produces weaker absorbed species at the electrode surface during the electro-oxidation process. Overall, we found that EG is more susceptible to undergo C-C bond scission under both close and far from equilibrium regimes. At presently we are employing in situ techniques to uncover some mechanistic aspects present in these systems. So far, our results have contributed to the current understanding of the electrochemical processes associated to the C-C scission during the electro-oxidation of small organic molecules. This is a key issue when considering ethanol in, high-performance, fuel cells devices.

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