STAINLESS STEEL-BASED ELECTROCATALYSTS FOR SULFITE OXIDATION IN ALKALINE MEDIA

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Sulfites are a secondary product resulting from a lot of industrial processes, such as the combustion of fossil fuels, especially solid fuels. These processes lead to increasing level of pollution. Due to their very strong reducing character, the elimination of sulfites in the environment profoundly affects the fauna and flora of the environment, which is why it is necessary to "neutralize" this category of pollutants. The simplest method of eliminating the negative effects of sulphite ions is their oxidation to sulfate, a process that can be carried out chemically or electrochemically. To reduce the costs related to the oxidation of sulfites, their use as an anodic depolarizer in sulfite/air fuel cells has been proposed. In such a fuel cell, the oxidation of sulfite to sulfate (1) takes place at the anode, while the reduction of oxygen takes place at the cathode.

The electrochemical oxidation of tetravalent sulfur compounds, S(IV), containing oxygen, such as SO2(aq), HSO_3^- and SO_32^-, has attracted attention in the development of hydrogen production and fuel cell technologies. In the anodic reaction, the most attractive catalysts are precious metals due to their electrocatalytic properties for the oxidation of these sulfur compounds. Given the high price of these metals, some non-precious metal and carbon-based catalysts have been investigated to reduce costs. Over time, several reaction mechanisms have been proposed, but the oxidation process of these compounds is currently unclear, being considered a complex transformation. Studies on this process have shown that the electrochemical oxidation mechanism of sulfite depends on the anode material, the pH and composition of the solution, and the current density.

In our experimental studies a cell connected to the potentiostat/galvanostat SP 150 Bio-Logic was used during all experiments. The working electrode was a bar of different stainless steel with an active surface of minimum 0.2 cm^2. Two graphite bars were used as counter electrodes and Ag/AgCl as the reference electrode. Hydroxide de sodium NaOH and sodium sulfite Na_2SO_3 were used to prepare the electrolyte solution.

Cyclic voltammograms, plotted on stainless steel, in 1 mol L^{-1} NaOH solution, at different sulfite concentrations between 10^{-3}M and 1M, highlighted the peaks characteristic of sulfite ion oxidation. At higher anodic potentials, oxygen evolution occurs. The kinetic parameters (exchange current i_o and anodic transfer coefficient α) were determined by the potentiodynamic polarization method. The obtained values were comparable to those reported in the literature on noble metals, which opens the possibility of stainless steel being used as an anode in a sulfite/air fuel cell. The results obtained by potentiodynamic polarization were confirmed by electrochemical impedance spectroscopy.

References

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