Electronic transference assessment in a *Geobacter sulfurreducens* fuel cell

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Microbial Fuel Cell technology (MFC) is attracting growing interest as an environmentally friendly energy production system. Bacteria can be used in MFCs to generate electricity, while accomplishing the biodegradation of organic matters present in different kinds of wastewater (Logan, 2006). In this context, the electrochemical properties of rigid graphite and carbon Toray electrodes at pH 7, are investigated in experiments using medium prepared in anaerobic conditions inoculated with *Geobacter sulfurreducen*s (DSM 12127).
The voltammograms obtained in assays with carbon Toray in growth medium (acetate concentration: 60 mM), with and without bacteria, are shown in Figure 1. An important increase of the current intensities between 0.4 and 1 V vs. SCE is noticed after the addition of bacteria.

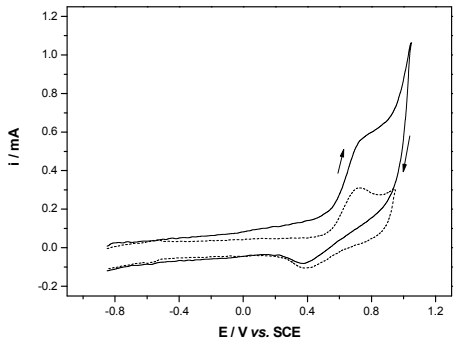

Figure 1. The voltammograms of carbon Toray electrodes in growth medium, with (—) and without (---) *Geobacter sulfurreducens* (75 mg/L) at 37º C (v = 50 mV s-1).

In order to assess the electronic transfer processes associated with the identified oxidation peaks in cyclic voltammograms, a cyclic voltammetric study was carried out. The influence of potential sweep rate on peak potentials and current densities allows to determine the reversibility of the process and the limiting step.

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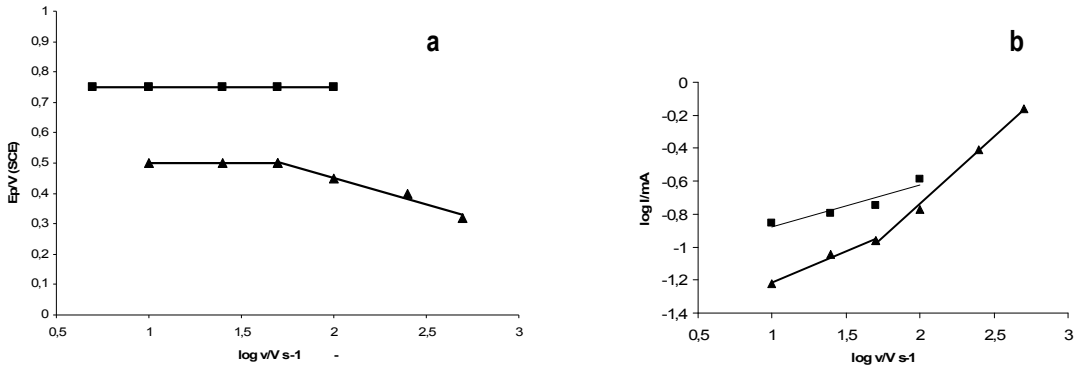

Figure 2. Graphic representation of (a) Ep vs. log v and (b) log I vs. log v whit carbon Toray (■) and rigid grafite (▲).

From the Figure 2 (a), it can be seen that for carbon Toray the potential of the oxidation peak (Ep) is independent of the sweep rate (v) showing a reversible process. Regarding the rigid graphite, between 10 and 50 mV s^{-1} the process seems to be reversible while from this last value up to 500 mV s^{-1} the dependence of Ep on v indicates an irreversible process.
Figure 2 (b) represents the dependence of log i on log v. The slope of the straight lines gives information about the nature of the limited step. With carbon Toray, the slope of 0,26 suggest a mechanism with numerous adsorbed species and products. No simple kinetic laws can be proposed in this case. For rigid graphite two distinct slopes are observed: 0.38 (between 10 and 50 mVs^{-1}) and 0.81 (between 50 and 500 mVs^{-1}). Considering this results it can be concluded that at low sweep rates the mechanism is governed more by diffusion, while adsorption takes more importance when increasing the sweep rate.
Other kinetic parameters of the reactions were also determined, namely the number of exchanged electrons.

References

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