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LOCAL ANALYSIS OF AEROBIC BIOCORROSION OF STAINLESS STEEL BY SCANNING VIBRATING ELECTRODE TECHNIQUE

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ABSTRACT

Mechanisms of biocorrosion of stainless steels in aerobic natural waters are still discussed although it is commonly agreed that the biofilm catalyses the cathodic reduction of oxygen [1-2]. Several hypotheses have been proposed to explain this catalysis: formation of hydrogen peroxide [3], modification of the oxide layer on material surface [4], presence of biological molecules (enzymes as peroxidase, catalase...) that intervene in the different steps of oxygen reduction. This last hypothesis has been focused in our group [5].

The objective of this paper is to demonstrate the ability of the scanning vibrating electrode technique (SVET) to determine the areas where this catalysis may occur. The SVET allowed establishing a map of the local currents flowing from the anodic and to the cathodic sites initiated on the surface. The experimental procedure was first designed with carbon electrodes and then extended to stainless steel. A strict protocol was defined to prepare the stainless steel and carbon electrodes by deposition of hemin on the surface. Hemin is a porphyrin compound similar to the active site of numerous oxidases (catalase, peroxidases...), which intervene in the reduction of oxygen and hydrogen peroxide. SVET was implemented on simple surfaces where a local galvanic coupling was created by depositing the catalyst on defined surface areas. Different local configurations were analysed, which clearly demonstrated the possible catalytic effect of adsorbed porphyrin in aerobic corrosion of stainless steel.

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