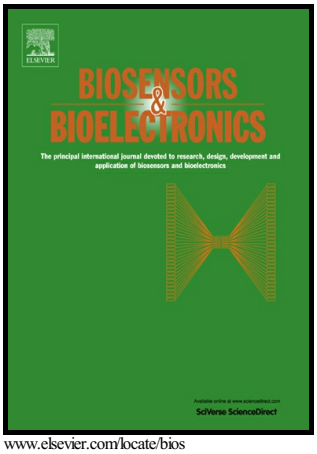

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Impact of electrode micro- and nano-scale topography on the formation and performance of microbial electrodes

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Abstract

From a fundamental standpoint, microbial electrochemistry is unravelling a thrilling link between life and materials. Technically, it may be the source of a large number of new processes such as microbial fuel cells for powering remote sensors, autonomous sensors, microbial electrolysers and equipment for effluent treatment. Microbial electron transfers are also involved in many natural processes such as biocorrosion. In this context, a huge number of studies have dealt with the impact of electrode materials, coatings and surface functionalizations but very few have focused on the effect of the surface topography, although it has often been pointed out as a key parameter impacting the performance of electroactive biofilms.

The first part of the review recalls some basics of the effect of surface topography on bacterial adhesion and biofilm formation, in a broad domain reaching beyond the context of electroactivity. The second part gives an overview of the influence of electrode topography on abiotic electrochemical reactions. On these well-established bases, the effect of surface topography is reviewed and analysed in the field of electroactive biofilms. General trends are extracted and fundamental questions are pointed out, which should be addressed to boost future research endeavours. The objective is to provide basic guidelines useful to the widest possible range of research communities so that they can exploit surface topography as a powerful lever to improve, or to mitigate, the performance of electrode/biofilm interfaces.

Keywords: Electroactive biofilm; Roughness; Microbial anode; Microbial fuel cell; Microbial electrochemical technology; Bioelectrochemical system.