Título: ADVANCING TOWARDS PRACTICAL APPLICATION OF EXOELECTROGENIC BIOFILMS

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> FUENTES NO CONVENCIONALES DE ENERGIA

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Resumen: Exoelectrogenic biofilms are consortia of microorganisms that can transfer the electrons resulting from its metabolism to external electron acceptors, including solid elements. This metabolic particularity, which is widespread in nature, has been technologically exploited in bioelectrochemical systems which use exoelectrogenic biofilms as catalysts in reduction/oxidation reactions in electrochemical cells. This biocatalysed electrochemical cells are finding multiple applications in energy production and waste management fields, activating new synergies between them since these devices could be envisaged as a nexus between electric and chemical energy.
The main objective of this thesis is to advance towards the application of exoelectrogenic biofilms involved in bioelectrochemical oxidative processes, specifically in bioelectrochemical enhancement of anaerobic digestion and organics degradation.

The first focus of application was the improvement of anaerobic digestion, trying to make it more resilient to the accumulation of volatile fatty acids (propionic) and to increase methane production. In this regard, the utilization of the bioelectrochemical enhancement proved to improve methane production and ameliorate propionate accumulation. The use of exoelectrogenic biofilms in technologies such as anaerobic digestion led to the conclusion that these biofilms will often work in conditions where dissolved oxygen could be present. This idea was developed in a specific chapter which concluded that the proliferation and biocatalytic activity of Geobacter based biofilms depends on the anaerobic microenvironment provided by aerobic microorganisms.
The second application focus of the thesis was the 2-mercaptobenzothiazole (MBT) degradation, where the biotoxicity of MBT-contaminated streams was reduced in a biocatalytic oxidation process in a microbial electrolysis cell. This application showed the benefits of electrodeposited graphene oxide enhanced electrodes, a materials modification process that was previously developed in a separate chapter. The graphene oxide modified electrodes revealed an accelerated start-up process, a robust biofilm formation and a selective enrichment in the exoelectrogenous genus Geobacter. The success in the application of graphene oxide modified electrodes prompted the search for
materials with new properties for exoelectrogenic biofilms development, which led to the investigation of polylactic acid/graphene electrodes, which have a performance comparable to materials conventionally used in microbial electrochemical technologies and it can be constructed in complex shapes through additive manufacturing.