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EA-BIOFILMS
NEST ADVENTURE

Biofilms are associated with many industrial corrosion phenomena.

Sparks from bacteria can power the future

Electrochemically active biofilms, which can achieve a direct electrochemical connection when they form on a conductive material, may be the basis of a new power source. Biofilms of micro-organisms form naturally on solid surfaces. Until now, they have been seen as harmful, either to human health, or to industrial products. But recent research suggests they have properties which can be used to catalyse or control electrochemical reactions, and could lead to a wide range of new products and processes over the next decade.

Recent research has identified the phenomenon of electrochemically active biofilms (EABs). So far, however, these results have come mainly through chance. And while they promise wide-ranging new applications in fields such as bio-energy, bio-remediation, chemical/biological synthesis, bio-corrosion mitigation and biosensors, the science is still at an early stage. Pursuing this research will allow scientists to increase their understanding of biofilms, which form naturally on a wide range of surfaces.

A multidisciplinary team of researchers from France, Italy, Germany, Belgium and Portugal, has set out, in an EU-funded project, to test a wide range of micro-organisms and identify those which are electrochemically active. Rather than growing new genetically engineered micro-organisms, as other research teams are doing, this team will take advantage of natural biodiversity and test existing microbial fauna.

Over a period of two years, they will screen a range of media, such as aerobic and anaerobic sea waters. Their aim is to identify the micro-organisms which form EABs through observing their behaviour on different electrodes.

Do it yourself

The challenge then moves on to growing these EABs under laboratory conditions, trying to recreate the properties exhibited in their natural state. The ability to do this reliably is, of course, the first step in developing industrial applications for EABs. In the laboratory, the team will also attempt to optimise the performance of the biofilms.

Laboratory work will be devoted to increasing understanding of the mechanisms of EAB formation. For example, why only specific organisms appear to be electrically active, the media and conditions in which they are electrically active, and the process in which EABs form.

Expanding knowledge

The team brings together a strong range of expertise in electrochemistry, materials and chemical engineering and microbiology. They aim to build a large, consistent and extensive database of a range of EABs. This

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The occurrence of EABs could offer potential improvements in production cost-effectiveness in the mining industry, particularly for the extraction of precious metals.

AT A GLANCE

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Electrochemical control of biofilm-forming micro-organisms: screening, identification, and design of new knowledge-based technologies

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will represent a significant increase in knowledge of EABs – in particular establishing whether there is a single model or not. Furthermore, assessing the actual electron transfer rate in the electrical connections formed will be a major contribution to assessing the feasibility of linked technologies and applications.

Most micro-organisms growing in the natural environment form biofilms on solid surfaces, such as metals, plastics or ceramics. These are usually seen as producing adverse effects on human health, through infection, or on industrial products, through biodegradation or corrosion, for example. It is estimated that corrosion costs developed countries around 4% of GNP annually, although the underlying causes are not well understood. Improving knowledge of EABs should improve knowledge of the causes of corrosion and, therefore, our ability to prevent it. But harnessing EABs is about much more than correcting negative effects.

> **Establishing the means to harness electrochemically active biofilms will result in a wealth of new scientific and technological applications.**

Powering the future

The EAB phenomenon is gaining great importance through the hope that it can bring a breakthrough in fuel-cell technology. Applications for EABs might include new synthesis routes in biotechnology and food production, new strategies for protecting materials, new biosensors, implanted power sources connected directly to metabolisms, and new therapeutic processes.

In short, if the early results can be reproduced widely, the application of EABs could represent a massive take-up of natural power from bacteria in a wide range of fields.

SIXTH FRAMEWORK PROGRAMME