Graphene foams as new cathode and anode materials for microbial fuel cells

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Abstract

During the last decade, microbial fuel cells (MFCs) have been intensively studied as a possible technology for energy production. MFCs have the tremendous potential of directly harvesting chemical energy from several classes of environmental and waste waters, profiting from the metabolic activity of exoelectrogenic bacteria [1, 2].
In MFCs a biological oxidation process occurs at the anode in anaerobic conditions, and at the cathode a reduction reaction takes place, usually involving oxygen as the electron acceptor. The proper design of the electrodes plays a key role in improving the final performance of the device.
Due to its excellent electrical, mechanical and electrochemical properties, graphene is a versatile material to use in the design of well-performing devices [3]. Graphene foams, with their high surface area can be a strategic choice for the design of both new anodes and new cathodes. First reported in 2011 [4], graphene foams are synthesized by Chemical Vapour Deposition (CVD) on sacrificial, commercially-available nickel foam templates. They retain many of the unique properties of 2D graphene while exhibiting a free-standing structure with pores in the range of 200-400 μm (Figure 1a).

In this work, we investigate the compatibility of graphene foams with bacteria growth, showing that the use of these templates is well compatible with the proliferation of microorganisms (Figure 1b). Moreover, the catalytic efficiency of the graphene foams for the oxygen reduction reaction using the rotating ring disk electrode is proposed.

References

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Figures

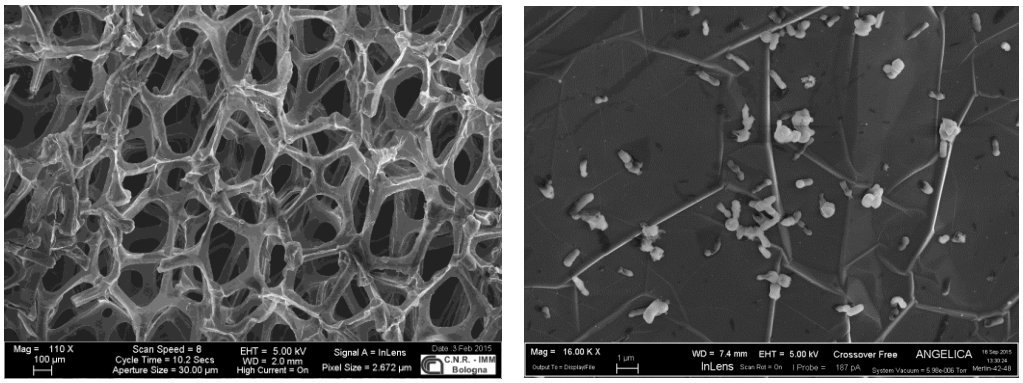

Figure 1. SEM images of a) free-standing graphene foam, after removal of the sacrificial Ni template, and b) proliferation of microorganisms on the surface of a graphene foam.