Pre-colonization of anodic electrodes in seawater sediment for Single Chamber Floating Microbial Fuel Cells application

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In order to power remote environmental sensors and/or data transmission devices, Sedimentary Microbial Fuel Cells (SMFCs) have proven to be a useful technology, representing a continuous source of renewable and sustainable energy [1]. SMFC functioning is based on a buried bioanode and an air cathode. The bioanode is constituted by an electrode colonized with microrganisms capable to oxidize organic compounds present in the environment, thus releasing electrons. The cathode is arranged at a certain distance from the anode, over the surface of soil (for terrestrial applications) or seawater (for marine applications), and close the electrical circuit by reducing oxygen. This configuration induces large ohmic losses and represents one of the main limits for the development and application of this technology. In order to overcome this limitation, a new architecture, named Floating Microbial Fuel Cells (FMFCs) has been proposed [2].

In the present work, the performance of Single Chamber FMFCs (scFMFC) in marine environment was investigated. To develop a biofilm in equilibrium with this specific environment and to reduce the start-up time of the scFMFCs, a method for anodic in situ colonization was exploited. After 50 days of pre-colonization, carbon felt-based anodic electrodes were used to build different replicas of scFMFCs; the scFMCs overall performance were evaluated over a period of one month of operation in the Mediterrean Sea. The study demonstrated a very short start-up time equal to 3/5 days, as well as a high stability of the scFMFCs even in real, uncontrolled environment. The easy preparation procedure of the anodic electrodes together with the simple architecture of the scFMFC suggested the use of these devices as power supply for environmental sensors in hostile environment such as open sea application.

[1] Zabihallahpoor et al., RSC Adv. 5 (2015) 94171

[2] Schievano et al., J. Power Sources 340 (2017) 80