Enhanced microbial electrosynthesis with three-dimensional graphene functionalized cathodes fabricated via solvothermal synthesis

The biological reduction of CO₂ into multicarbon chemicals can be driven by electrons derived from the cathode of a bioelectrochemical reactor via microbial electrosynthesis (MES). To increase MES productivity, conditions for optimal electron transfer between the cathode and the microbial catalyst must be implemented. Here, we report the development of a 3D-graphene functionalized carbon felt composite cathode enabling faster electron transfer to the microbial catalyst Sporomusa ovata in a MES reactor. Modification with 3D-graphene network increased the electrosynthesis rate of acetate from CO₂ by 6.8 fold. It also significantly improved biofilm density and current consumption. A 2-fold increase in specific surface area of the 3D-graphene/carbon felt composite cathode explained in part the formation of more substantial biofilms compared to untreated control. Furthermore, in cyclic voltammetry analysis, 3D-graphene/carbon felt composite cathode exhibited higher current response. The results indicate that the development of a 3D-network cathode is an effective approach to improve microbe-electrode interactions leading to productive MES systems.

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