Breakthroughs in microbial-fuel-cell anode material achieving high power density

Supported by the National Natural Science Foundation of China, the team led by Prof. Liu ShaoQin (刘绍琴) from the School of Life Science and Technology, Harbin Institute of Technology, made progress in anode materials of microbial fuel cells, which was published in *Advanced Materials* (2018, 30(22): 1800618).

Microbial fuel cells (MFCs), in which electricity is generated based on metabolism of organic compounds by electrochemically active microorganisms, are able to bring together energy production and wastewater treatment in a sustainable and cost-efficient way. Till now, progress has been made in terms of efficiency and applicability of MFCs, but the difficulty of achieving the high power especially in real samples remains a bottleneck for their practical applications. Generally, the anode that serves as the habitat for microorganisms mainly determines MFC performances. Prof. Liu et al. suggest using graphene decorated with FeS_2 nanoparticles as MFC anode based on the fact that anchoring of FeS_2 nanoparticles over graphene not only increases the surface area and electrical conductivity of graphene, but also enriches *Geobacter* species on the electrode substrate and facilitates extracellular electron transfer in MFCs. As a result, the FeS_2 nanoparticles decorated graphene anodes give rise to a fast start-up time of 2 days, an unprecedented power density of 3220 mW m^{-2} and a remarkable current density of 3.06 A m^{-2} in the acetate-feeding and mixed bacteria-based MFCs. Most importantly, the FeS_2 nanoparticles decorated graphene anodes successfully run an electromagnetical pendulum and achieve a power density of 310 mW m^{-2} with simultaneous removal of 1319 ± 28 mg L^{-1} COD in effluents from a beer factory wastewater. The characteristics of improved power generation and enhanced pollutant removal efficiency open door towards the development of high-performance MFCs via rational anode design for practical application.

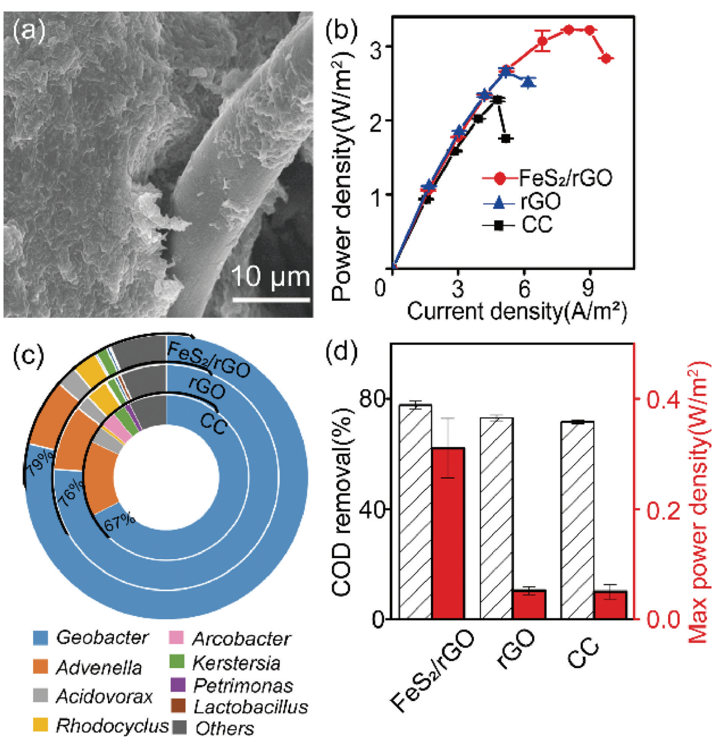

Figure (a) SEM image of biofilm growth on the FeS_2/rGO anode. (b) Polarization and power density curves of different anodes. (c) Structure of microbial community at different anodes. (d) Correlation between COD removal efficiency and maximum power density of different anodes for the treatment of effluents from a beer factory wastewater.