Abstract

The algae-based biofuels have been proven promising for the future energy security. The process of algae cultivation is well complemented by microbial fuel cell (MFC). The CO_2 supplied from anodic chamber can be utilized for algae growth in the cathodic compartment, and the O_2 provided by algae can act as a terminal electron acceptor at the cathode. Despite holding high potential, the MFC technology bears certain bottlenecks such as high capital cost involved in the fabrication & operation of MFC reactors, the requirement of continuous supply of electron donor substrate in anodic chamber, expensive cathode catalysts & proton exchange membrane, low power output, and energy recovery in scaled-up reactors to name a few. In this context, algae-based MFCs are not extensively researched as bioenergy technologies and scale-up is not attempted in the literature. Therefore, the present study was carried out to address some of the limitations associated with MFCs. In this regard, a lab-scale algae assisted MFC system was developed, wherein algae is cultivated in the cathode chamber, algae biomass is harvested and lipids are extracted. The lipid extracted algal (LEA) biomass was then used as an electron donor substrate. The proposed system turned out to be a net energy producer that does not rely heavily on the external supply of electron donor substrates. This process was further scaled-up to 10 L under outdoor conditions. This outdoor system generated a net 11.53 kWh/m^3 energy at the cost of $11.225 only. Also, the graphite/CuO composite electrode (with a much simplified preparation) was found to support good electrochemical activity, power output, and algae growth. In summary, the thesis work addresses some of the bottlenecks in MFC technology and develops a low-cost algae-assisted microbial fuel cell with a potential for commercialization.