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Conversion of carbon dioxide to C1 and C2 biofuels using bioelectrochemical systems

Mohammad Zain Khan, Abdul Hakeem Anwar and **Saima Sultana**
Aligarh Muslim University, India

Energy is essential component of our society to support day-to-day activities like powering home appliances, lightning, transportation, heating/cooling etc. The global energy consumption was around 520 quadrillion BTUs (British Thermal Units) in 2010 and is expected to increase by 56% to 820 quadrillion BTU by 2040. At present, 78% of our global energy consumption comes from non-renewable resources like coal, petroleum, natural gas and that only 19% of the present energy comes from renewable energy sources. Energy crisis and pollution are biggest problems the world is facing today. Since the fossil fuels are depleting day by day and fossil fuels create pollution. Diminishing reserves and rapidly increasing energy consumption clearly suggest that we must act urgently and decisively to develop clean, sustainable, affordable and renewable energy sources. Hence waste which is biodegradable and renewable can be used and can make energy and reduces dependence on fossil fuels and pollution. Around 2.2-4.4*1018 joules of energy (corresponding to 70-140 GW electricity) can be generated from waste produced by the whole 7 billion population of the world if proper Waste to Energy (WTE) strategies are employed. A number of technologies are available for WTE such as incineration, anaerobic digestion, pyrolysis and gasification, bio-electrochemical systems etc. Microbial electrolysis cell is a rapidly growing bioelectrochemical system (BES), wherein an electrochemical process takes place under the influence of biological catalyst to generate energy by utilizing a wide range of substrates. MECs are unique systems capable of converting the chemical energy of organic waste including low-strength wastewaters and lignocellulosic biomass into electricity or hydrogen or other value added products (biofuels). Various designs of MECs are possible including single and dual chambered systems. The performance of these systems is controlled by various factors e.g. pH, temperature, catalyst loading, solution conductivity, amount of substrate, etc. In the present work, a dual chambered MEC has been constructed with a working volume of 100 mL. Carbon felt was used as electrodes and the two chambers were separated by proton exchange membrane. Glucose was added in to the anodic chamber in order to support microbial growth while carbon dioxide was bubbled in to the cathodic chamber. The hydrogen ions thus produced during the degradation were transferred through the membrane to cathodic chamber wherein they combine with carbon dioxide to form methanol and ethanol.

dr_mzain.fa@gmail.com