The optimization of hyperthermophilic biohydrogen production from unpretreated cattle manure

Hydrogen (H_2) is projected as a superior energy carrier since it has remarkably higher energy yield (122 kJ/g) compared to any known hydrocarbon fuel, and its combustion only generates water vapor as a by-product. However, currently 96% of global hydrogen demand has been met using fossil fuels, which is releasing significant amount of carbon dioxide (CO_2) to the atmosphere. Therefore, there is an urgent need to develop alternative sustainable systems that are cost-effective. Dark fermentation (DF) is a biological process, through which anaerobic microorganisms produce hydrogen from biomass in the absence of oxygen. Among various types of fermentative microorganisms, (hyper)thermophiles present ideal candidates for hydrogen production mainly because it is possible to achieve better hydrolysis of complex materials with higher hydrogen production yields and lower risk of contamination by methanogens. Utilizing widely available, inexpensive raw materials without any pretreatment, as a substrate for biohydrogen production can play an important role to make the DF process more sustainable and cost-effective. In this thesis, we will investigate hyperthermophilic biohydrogen production from unpretreated cattle manure as a sustainable and low-cost carbon source by DF process. Further, since DF process effluents contain other fermentation products such as acetic acid, they can be fed to microbial electrolysis cell (MEC) system for increased hydrogen production. As a polishing step of DF process, we will also investigate a series operation of DF-MEC system.