EXPERIMENTAL ANALYSIS OF AN UNDESIRABLE CRYSTAL PRECIPITATE IN A DEVELOPMENTAL CARBON FUEL CELL

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Abstract

Carbon fuel cells have the potential to generate electricity from biocarbons with a theoretical thermodynamic efficiency of 100%. A higher efficiency in generating electricity will mean that less biocarbons will need to be used to realize the same electricity output. This efficiency and the use of a clean energy alternative can help reduce our consumption of fossil fuels and reduce our carbon emissions. The goal of this project is to determine the chemical composition and formula of an unwanted crystal precipitate being produced from a carbon fuel cell and to determine the thermodynamic properties of the crystals in order to prevent them from forming in the fuel cell during operation. The carbon fuel cell is being developed in the Renewable Resources Research Laboratory at the Hawaii Natural Energy Institute. The chemical composition of the precipitate was determined by thermogravimetric analysis and mass spectrometry by the Hungarian Academy of Sciences. Once the composition was determined, a pressure vessel immersed in a fluidized sand bath was used to determine the temperature and pressure at which the decomposition of the crystal precipitate in solution was observed. The complete decomposition temperature will determine the optimal operation temperature for the fuel cell. The unwanted crystal precipitate was discovered to be potassium bicarbonate. The potassium bicarbonate in solution was shown not to decompose at the same temperature as dry crystalline potassium bicarbonate. However, partial decomposition of potassium bicarbonate into potassium carbonate was observed at 300°C and 320°C. Further work needs to be done to study the kinetics of the decomposition reaction of potassium bicarbonate into potassium carbonate and to

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