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Conversion of Biomass to Green Hydrogen: Symbiosis Between Bioenergy and Hydrogen Economy

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Abstract

Biomass gasification contributes to the growing energy demand thus reducing reliance on fossil fuels and decreasing accumulation of greenhouse gases in the atmosphere. A new technology, in which biomass, considered as a renewable energy source, produces green hydrogen, as a fuel, is described. Willow was used as a model compound for biomass. The biomass-to-H_2 conversion was studied in supercritical water (SCW) using a Diamond Anvil Cell (DAC) at heating rates of 1 and 5 ° C/s and a Continuous Flow Reactor (CFR). The evolution pathway of cellulose and glucose, which are the building blocks of any biomass, was determined (selected experiments were conducted *in-situ* under a synchrotron environment). In addition, a conversion mechanism, based on a rapid hydrolysis of cellulose to oligomers and glucose, was suggested. Successful gasification of 0.1 M biomass mixture was achieved with an acceptable selectivity for hydrogen (44%). A mixture of H_2, CO_2 and CH_4 gas was also produced. Quantitative analysis of the total organic carbon (TOC) in the residue indicated 67% carbon gasification efficiency at 330° C. Results of this work have led us to propose a continuous process allowing for efficient generation of hydrogen from biomass. Based on the DAC and CFR experiments a new technology, in which a renewable biomass is used to produce hydrogen fuel, was developed. The biomass-derived green hydrogen could be used as a feed for fuel cells to generate electricity.