Formic Acid-Based Fischer-Tropsch Synthesis for Green Fuel Production from Wet Waste Biomass and Renewable Excess Energy

J. Albert*, A. Jess**, C. Kern**, F. Pöhlmann**, K. Glowienka** P. Wasserscheid*/***
*Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, **Universität Bayreuth, Germany,***Forschungszentrum Jülich GmbH, Helmholtz-Institut Erlangen-Nürnberg for Renewable Energy, Erlangen, Germany

Abstract

Growing concerns about global warming have created a world-wide interest in new concepts for sustainable and biomass-based future energy supplies. A main interest of related research efforts is to provide liquid transportation fuels from biomass waste or non-edible biomass resources as competing use of agricultural products for feeding people or animals against its conversion to fuels is increasingly inacceptable in the light of a still growing global population. While the production of hydrocarbons by Fischer-Tropsch synthesis (FTS) is a widely recognized, yet technically quite complex way to transform biomass via syngas (mostly from biomass gasification) into liquid fuels, we here present an alternative route transforming biomass first into formic acid (FA) followed by syngas formation by decomposition of FA and finally FTS using regenerative hydrogen (or if needed H2 from the stored FA) to balance the C:H ratio. The new method builds on the recently developed, selective oxidation of biomass to formic acid using Keggin-type polyoxometalates as homogeneous catalysts, oxygen as the oxidant and water as the solvent. This method is able to transform a wide range of complex and wet biomass mixtures into FA as the sole liquid product at mild reaction conditions (90 °C, <10 bar O2). We propose to convert FA with hydrogen from water electrolysis - the electrolysis step producing also the oxygen for the biomass oxidation to FA – to green hydrocarbon fuels using a typical Co-based FT catalyst.