Converting Cellulosic Biomass to Liquid Fuels using Sulfur Doped Titanium Dioxide Photocatalyst in Aqueous Solutions

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Abstract

Liquid acids are commonly used to catalyze the hydrolysis of lignocellulose biomass. Liquid acids suffer from low recyclability and their use results in reactor corrosion. Ideally, a catalyst is wanted the can catalyze hydrolysis in water and offer good solubility of cellulose. This research tested sulfur doped titanium dioxide as a catalyst for cellulose hydrolysis as it is proposed that this catalyst will have catalytic activity and good recyclability based on previous research[1] of titanium dioxide in the decomposition of organic compounds in water. Titanium dioxide and two variants of sulfur doped titanium dioxide were tested by adding 0.5 g of catalyst to 100 ml of water with 1.00 g of cellulose. These were then heated for 4 hours at 100℃ under no light, incandescent 150W light, or UV 26W light. Based on initial reactions that tested each form of catalyst at each type of light, XRD analysis of solids, and NMR analysis of liquids; titanium dioxide and both forms of sulfur doped titanium dioxide did not produce oil in this methodology. Due to the high solubility of titanium dioxide in water, it also has very poor recyclability seen by a post reaction solid that is a mixture of cellulose and titanium dioxide and water still containing titanium dioxide. The methodology in this research should be modified in the future to reflect methods used to clean water with titanium dioxide by using glassware with a thin film of titanium dioxide[2].

References Cited

[1] L. Gomathi Devi, R. Kavitha. "Enhanced photocatalytic activity of sulfur doped TiO_2 for the decomposition of phenol: A new insight into the bulk and surface modification." *Materials Chemistry and Physics* 143 (2014): 1300-1308. Print
[2] The Royal Society of Chemistry "TiO_2: A New Kind of Water Treatment." *Learn Chemistry* (2013): Online Education Journal

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Brief Bio

Charles Dow is a Senior Chemical Engineering student at the University of New Haven. He has been a student member of the Center for Integrative Materials Discovery, led by Dr. Dequan Xiao, since November 2016. His SURF research was part of his catalyst design research for IMD. He will be doing further research with Titanium Dioxide as a catalyst for organic compound decomposition in air.