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Analysis of ultrastructure properties of cell walls in dilute acid pretreated biomass by confocal Raman microscopy

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Abstract

The effect of dilute acid pretreatment on the hydrolysis of lignocellulosic biomass was investigated, based on the chemical and ultrastructure properties of cell walls. Oxalic acid and sulfuric acid used as chemical catalyst. Confocal Raman microscopy was used to gain improved understanding of how acid pretreatment disrupt lignocelluloses cell walls. Total fermentable sugar (glucose and xylose) in the oxalic acid hydrolysate was as high as 26.18 g/L, compared to that of sulfuric acid hydrolysate. The chemical composition of the pretreated biomass differed slightly, depending on the acid catalyst. Considerable xylan was degraded, during oxalic acid pretreatment. The glucan and lignin contents were relatively increased in the oxalic acid pretreatment. Among two acid pretreatment, oxalic acid was more effective on enzymatic hydrolysis, with 29.46 g/l of total fermentable sugar after 96 h. Optical microscopy showed the dilute acid pretreatment significantly changed the cell wall structure, where disrupted cell walls during pretreatment can clearly be seen. Based on confocal Raman peak intensity, the dilute acid pretreatment resulted in change of 900 cm^{-1} and 1600 cm^{-1} band which described about the cellulose and lignin structure and distribution respectively.