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The POM-IonoSolv-Process: A new innovative system for selective, oxidative conversion of lignocellulosic biomass

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PURPOSE OF THE ABSTRACT

Lignocellulosic biomass is an attractive alternative to petroleum regarding the production of biofuels, bio-based materials and platform chemicals. Lignocellulosic biomass is generated?carbon-neutral from available CO2, water and sunlight and is therefore an important and renewable source of energy and the only renewable source of carbon that can be provided sustainably in large quantities. However, deriving value from lignocellulose is more challenging due to the higher complexity of the raw material and its higher recalcitrance towards selective processing. Lignocellulosic biomass typically consists of hemicellulose (25 %), lignin (25 %), cellulose (40 %) and ca 10 % other, minor components. [1] While cellulose is an attractive product for material applications, such as paper, hemicellulose and lignin can be further used for energy generation and at least partly for production of bulk chemicals. [2, 3]

Formic acid (FA) is an important bulk chemical that is widely used in chemical, leather, pharmaceutical, rubber and other industries. [4] Furthermore, FA can be easily and selectively decomposed to hydrogen and CO2 under mild reaction conditions. Hence, FA can be regarded as an attractive hydrogen storage material. [5, 6]

In this contribution, we present our innovative approach for fractionation and conversion of lignocellulosic biomass using a novel combination of low-cost acidic ionic liquids and polyoxometalate (POM)-catalysts. Within our process, hemicellulose and lignin are selectively dissolved out of complex biomass and in-situ oxidized to formic acid using a POM catalyst dissolved in the ionic liquid. We show that most of the cellulose remains in the solid pulp, providing potential for utilising the cellulose as material or releasing the sugars in a separate setup. Several parameter variations were performed in order to optimize biomass conversion, yield of formic acid and quality of remaining cellulose. Beside variation of catalyst composition, reaction matrix and substrate we performed a sensitivity analysis of the process regarding reaction temperature, residence time and substrate to catalyst ratio. Furthermore, the liquid catalyst containing catalyst phase was successfully recycled several times.

FIGURES

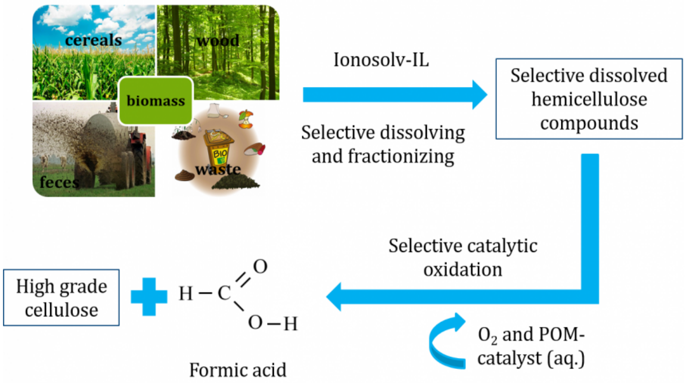

FIGURE 1

Concept of POM-IonoSolv-Process

Illustration of POM-IonoSolv-Process: selective conversion of lignocellulosic biomass to formic acid and high-grade cellulose

FIGURE 2

KEYWORDS

Lignocellulosic biomass | Biomass fractionation | ionic liquid | polyoxometalate

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