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Integrated process for ethanol production from lignocellulosic biomass

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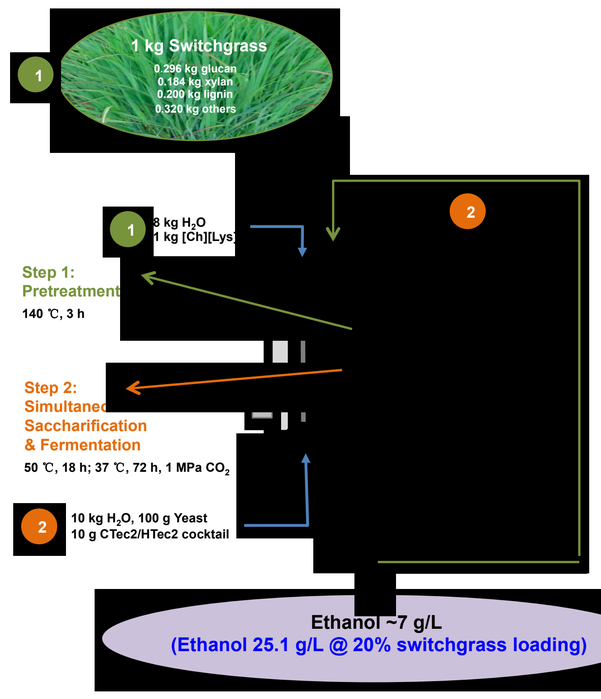
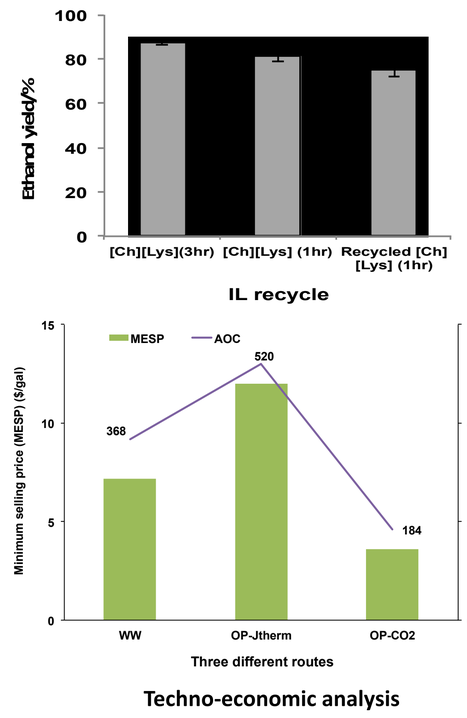
Abstract

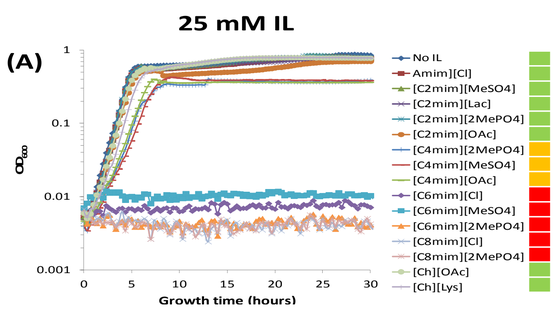
Ionic liquid (IL) pretreatment has significant potential in facilitating the fractionation and separation of biomass components in a biorefinery concept. The chemistry involved during IL pretreatment largely depends on the selection of anions and cations, the pretreatment process conditions, as well as the biomass recovery methods. These all influence how the biomass is being altered during the pretreatment process. IL pretreatment is experiencing a period of rapid technology development, augmented by the discovery of new ILs, new process configurations, and the nature of ILs as designer solvents. This poster will cover the current state of IL pretreatment technology at JBEI and briefly provide an outlook on several different technology scenarios.





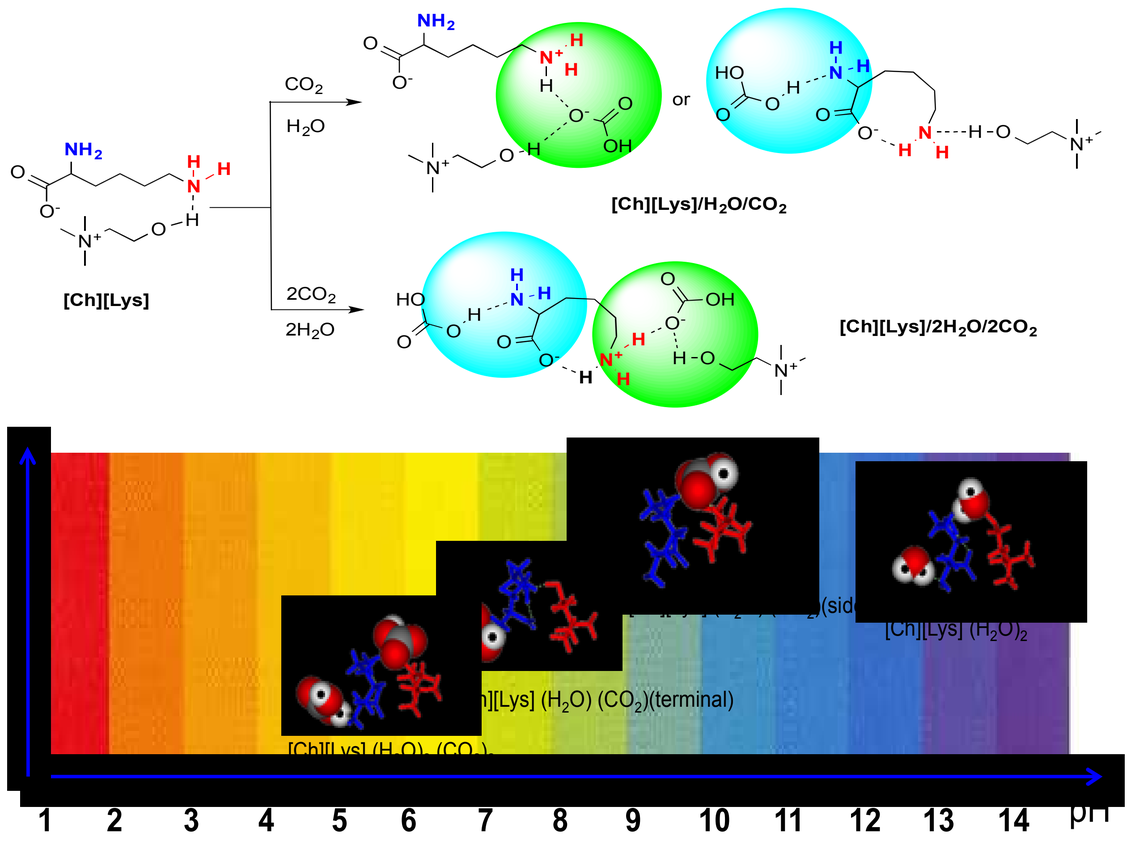
Biocompatibility and IL-CO_2 Chemistry

By exploring the chemistry between CO_2 and the biocompatible IL, [Ch][Lys], we developed an integrated IL process for the production of ethanol with 83.3% theoretical yields without removal of IL before saccharification and fermentation, and achieved a significantly improved overall economics by reducing IL and water usage as well as the avoidance of intermediate separation steps.



Green: no effect on growth;
Orange: retarded growth;
Red: no growth

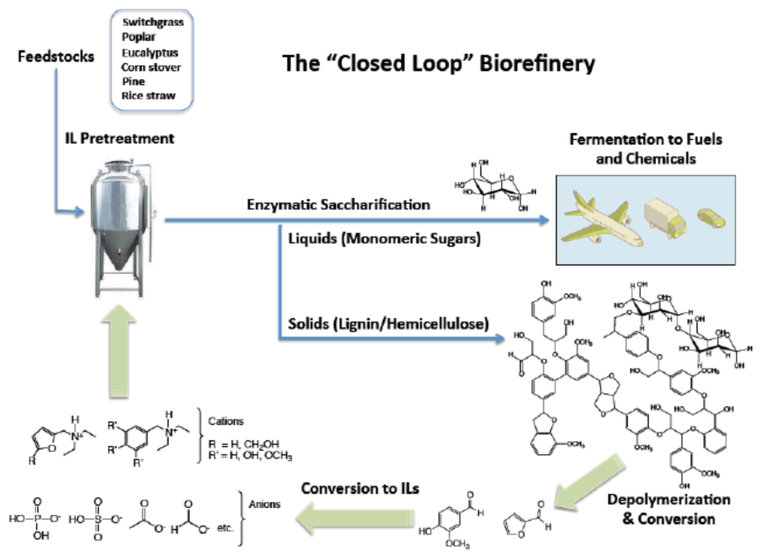
- Cation toxicity: C_8>C_6>C_4>Amim>C_2>Ch
- Anion toxicity: Ac>Lac>Cl>$MeSO_4$~Me_2PO_4>Lys

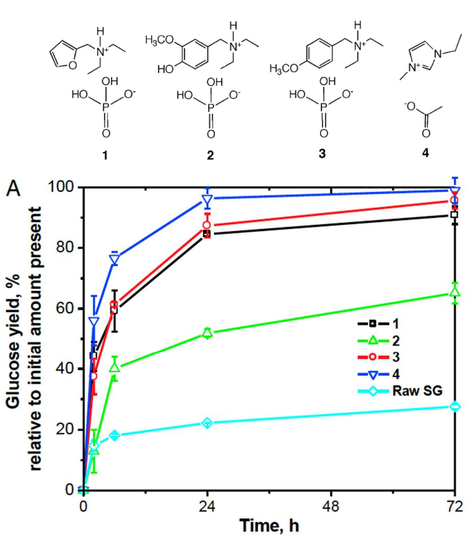


Lignin derived renewable ILs

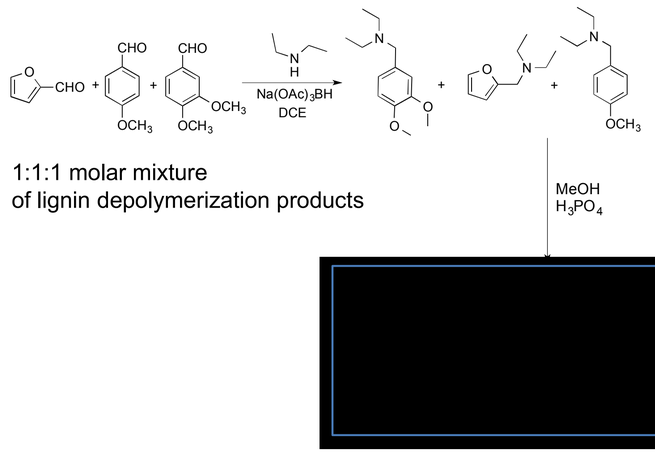
To improve the commercial viability of a biorefinery, we have developed a technology so that the byproducts from lignin and hemicellulose can be converted into renewable ILs without any purification. These IL mixtures have excellent pretreatment efficiencies. Also a more inexpensive route to convert monomeric, oligomeric and even polymeric lignin to ILs was developed in our lab. Those ILs can be applied for integrated process for biofuel synthesis in our future work.

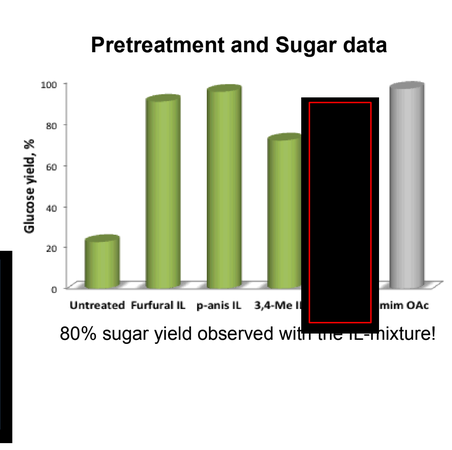
Lignin depolymerized product to IL :





Lignin depolymerized product mixture to IL :





80% sugar yield observed with the IL-mixture!

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Exceptional service in the national interest