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ONE-POT ENZIMATIC DEPOLYMERIZATION OF CELLULOSE IN IONIC LIQUIDS

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Green alternatives to fossil-based fuels are very attractive and can be produced from cellulosic materials. Cellulose is the primary product of photosynthesis in plants and has immense importance as a renewable raw material. The production of biofuels starting from cellulose is gaining increasing attention and obviously implies the partial or total hydrolysis of cellulose: enzymatic processes are considered the most promising technology [1].
Cellulases (EC 3.2.1.4) are the enzymes most commonly employed to selectively depolymerize cellulose in buffered aqueous solvents. Because of the very low solubility of cellulose due to its highly organized structure, enzymatic conversions proceed at very slow reaction rates and require the dissolution in a solvent to facilitate the access of cellulases to cellulosic substrates. To improve the yield of fermentable monosaccharides, pretreatments of cellulose, such as thermal, chemical or physical treatment, have been applied to afford a better enzymatic conversion [2].

Ionic liquids (ILs) have been increasingly recognized as excellent solvents for dissolution and pretreatment of cellulose but it was previously reported that ILs induce usually fast enzyme deactivation by protein unfolding [3].
In the present work we present a study on a single-batch, homogeneous phase enzymatic hydrolysis of cellulose using three commercial ILs. We have tested two native proteins from *Trichoderma reesei* and *Humicola insolens* and two engineered proteins from *T. reesei* and *Streptomyces sp.*. In some cases ILs don't denature the cellulases used but increase their operational stability as compared to standard buffer solutions and facilitate the dissolution of cellulose. Interestingly, the stability of the four cellulases in the presence of the ILs allows to set-up a procedure lacking of the cellulose pretreatment step.
We believe that this strategy could be amenable of scale-up and innovative industrial applications for the efficient one-batch conversion of inexpensive cellulosic materials into derivatives (biofuels, derivatized cellulose, monosaccharides for fine chemicals, etc.) with high potential commercial interest and in the framework of environmentally friendly chemistry.

References

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