Title of the thesis	Integrated Biomass Fractionation and Platform Molecules production with Lignin Valorization
Acronym	MOLTEN
Reference number	033

Hosting institution	**Employer**
Université de Lille Website: https://www.univ-lille.fr/home/	CNRS Website: https://www.hauts-de-france.cnrs.fr/
Hosting research unit 1	**Hosting research unit 2**
Name: Unité de Catalyse et de Chimie du Solide Acronym: UCCS Identification number: UMR 8181 Address: Université de Lille Bâtiment C3 59655 Villeneuve d'Ascq Cedex Website: http://uccs.univ-lille1.fr/index.php/en/	Name: PhysicoChimie des Processus de Combustion et de l'Atmosphère Acronym: PC2A Identification number: UMR 8522 Address: Cité scientifique Av. Mendeleiev Bâtiment C11 59655 Villeneuve d'Ascq Cedex Website: http://pc2a.univ-lille.fr/fr/presentation
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Thesis information

Keywords	Lignocellulosic biomass; Fractionation; Biorefineries; Catalysis; Combustion.
Abstract	Lignocellulosic biomass is an abundant, non-edible and renewable resource for the production of high added-value chemicals and fuels in the future biorefineries. The first step in a biorefinery is the fractionation of lignocellulosic biomass into its components, which is followed by depolymerization and upgrading. These processes are usually performed separately and consecutively. In this PhD project, we propose to integrate these steps into a one-pot process to improve the viability of the biorefinery. One of the challenges is the pretreatment step due to the biomass recalcitrance. The approach of proposed PhD work is based on the use of abundant and "simple" inorganic molten salt hydrate ($ZnCl_2.xH_2O$) as solvent to extract carbohydrates from the biomass matrix. This fractionation technique has various advantages: inorganic molten salt hydrates are inexpensive, easily prepared from non-toxic precursors; they are recyclable; and exhibit high performance on cellulose and hemicellulose dissolution at low temperature. Different biomass wastes (wheat straw, corn stover) or crops (miscanthus) typical of the Hauts-de-France region and Netherlands will be used. Once cellulose and hemicellulose are extracted from the biomass matrix, they will be transformed into platform molecules in the same reactor where the fractionation takes place. This will be performed by using an innovative heterogeneous catalyst containing Brönsted acid sites and highly active transition metal nanoparticles deposited on magnetic core-shell support that will be designed and tested. The reaction involves the hydrolysis of the carbohydrates on the sulfonic groups grafted on the silica support followed by the hydrogenation of the sugars produced into sorbitol and xylitol using metal (Ru, Pd) nanoparticles and formic acid

	as a hydrogen donor. The magnetic core-shell nanoparticles allow the easy separation of the catalyst and its reuse. Lignin remains in the solid residue produced and it will be separated, characterized and tested for oxygen removal and production of hydrocarbons. The integration of biomass fractionation and carbohydrate conversion to platform molecules at low temperature using low-cost and environmentally friendly solvents such as molten salt hydrates and multifunctional catalysts will improve the efficiency of the overall process, reduce the costs and increase its competitiveness. The potential to valorise lignin produced as biofuel will also be investigated. This is highly dependent on their reactivity towards ignition, i.e. their gas-phase oxidation mechanism at temperatures below 1000 K. This will therefore be evaluated through kinetic studies of their combustion in engine-relevant conditions, by measuring their ignition delays in a well-controlled environment, and identifying the major reaction pathways involved. This in turn will permit the development of predictive tools of their reactivity, thus facilitating their introduction into commercial fuels. This thesis will be carried out at Unité de Catalyse et de Chimie du Solide (UCCS) and Physico-Chimie des Processus de Combustion et de l'Atmosphère (PC2A) in Lille. The PhD student will also perform a research stay at University of Wageningen in Netherlands for 10 months. During his/her PhD the candidate will disseminate his results on international congresses in the field of catalysis, chemical engineering and combustion.
Expected profile of the candidate	We are looking for a graduate student with a Master´s degree in Chemistry or Chemical Engineering. In this multidisciplinary context, the PhD student must have skills in catalysis and green chemistry. A good knowledge in a subset of the following fields is expected: statistics, optimization, experimental design, chemical synthesis, chromatography and separation. Preferably, the researcher should have experience in carrying out catalytic assays, preferably in the liquid phase reactions and in the analysis of reaction products. The student should also be able to use a variety of techniques for catalyst characterization. Knowledge of written and spoken English is necessary for writing scientific articles and for communication about the work performed.
Application procedure & Eligibility criteria	The application procedure and eligibility criteria are detailed on the European doctoral programme PEARL website www.pearl-phd-lille.eu. The funding is managed by the I-SITE ULNE foundation which is a partnership foundation between the University of Lille, Engineering schools, research organisms, the Institut Pasteur de Lille and the University hospital. The application file will have to be submitted before March 31, 2021 (10:00 AM - Paris Time) and emailed to the following address : international@isite-ulne.fr.
Net salary and Lump Sum	A net salary of about €1,600 + €530 per month to cover mobility, travel and family costs.