L11
CATALYTIC CONVERSION OF BIO-SOURCED RAW MATERIALS: HOMOGENEOUS CATALYSIS

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Education

2008: Habilitation à Diriger des Recherches, University of Poitiers

Since 2002: Permanent CNRS Researcher at the University of Poitiers, Laboratoire de Catalyse en Chimie Organique, UMR 6503 CNRS-Université de Poitiers.

2001-2002: Postdoctoral position at the University of Rennes 1 (France) under the supervision of Pr. Pierre H. DIXNEUF

Topic: C-C bond coupling in the presence of ruthenium-based homogeneous catalysts

2000-2001: Postdoctoral position at the University of DAVIS-California (USA) under the supervision of Pr. Kevin M. SMITH.

Topic: Synthesis of porphyrins over solid supports

2000: PhD degree in chemistry at the University of Burgundy, Dijon (France) under the supervision of Pr. Roger GUILARD.

Topic: Synthesis of porphyrin/corrole bismacrocycle systems for the catalytic reduction of oxygene to water

1997: Master in Chemistry, University of Rennes 1 (France)

Research activities

My scientific researches are within the frame of green chemistry and are organized around three main axes that are (1) homogeneous catalysis, (2) renewable raw materials (mainly natural polyol such as glycerol, cellulose) and (3) the search of alternative media for catalysis. In all investigated reactions, we focus on the design of eco-efficient processes (atom economy, energy saving). To this end, a particular attention is given to the selectivity of reactions, the stability of catalysts, the choice of the solvent and the purification work-up.

Scientific publications

Total number of publications in International journal with reviewing committee: 46
International patents: 2
Book chapters : 2 (Wiley and Springer)
Invited conferences: 10 (7 in international congresses and 3 in national congresses)
Oral communications: 28 (13 in International congresses / 15 in national congresses)

Award

2010: prize of the French division of catalysis (Société Chimique de France), SCF-DIVCAT

Abstract
On the basis of recent examples, we will discuss here the potentiality of homogeneous catalysis for the conversion of biomass to valuable chemicals. In particular, homogeneously-catalyzed fractionation of biomass, conversion of carbohydrates and oils will be discussed. The recycling of homogeneous catalysts and synergistic effect between homogeneous and heterogeneous catalysts will be also described.

Introduction
With the disappearance of fossil carbon reserves and growing concern about climate changing, biomass is now being intensely investigated as a renewable raw material for industry [1]. The polyfunctionality and low solubility of biomass in conventional media require the design of innovative catalytic processes capable of (1) overcoming mass transfer problems and (2) activating biomass under mild conditions. In this context, homogeneous catalysis occupies a place of choice.

Results and discussion
Here we wish to show that homogeneous catalysis offer very efficient tools for selectively converting biomass to higher value added chemicals. Aim of this lecture is not to provide a complete overview of all works dealing with homogeneous catalysis applied to biomass but more to discuss on recently reported innovative strategies which contributed to convert biomass through eco-efficient routes. In most of presented examples, the possible recycling of homogeneous catalysts will be particularly discussed since this point represents today the main limitation of homogeneous catalysis.
After a brief introduction on biomass, we will first comment on the contribution of homogeneous catalysis for the fractionation of lignocellulosic biomass. This process is a necessary step that aims to release carbohydrates from which a large number of transportation fuels or chemical platforms can be then produced. Among them, we will particularly examine the case of cellulose. Cellulose is a biopolymer of glucose and its catalytic conversion is strongly limited by its high crystallinity [2]. In this context, we will show that recent works based on the smart combination of homogeneous and heterogeneous catalysis now offer efficient means for converting cellulose with a higher efficiency. In these “dual-processes”, homogeneous catalysts are generally employed for hydrolyzing cellulose to water-soluble carbohydrates which are further converted to valuable chemicals over solid catalysts. Such a concept can be also directly applied from lignocellulose. Here again, we will comment on the recycling of homogeneous catalysts.
Next we will shift to the catalytic conversion of vegetable oils. Catalytic conversions of fatty derivatives being already the topic of another lecture, this aspect will not be discussed here. Therefore, we will focus here only on the conversion of glycerol which is the co-product of the vegetable oil industry. In this context, catalytic telomerization of glycerol and its etherification with fatty alcohols will de described. These two catalytic reactions are of prime importance since they afford a direct access to valuable amphiphilic glycerylethers. In this field of chemistry, solid catalysts do not afford satisfactory results yet and these products are for the moment only accessible thanks to homogeneous catalysis.
Finally, in a last part, we will describe how the recent progress in the search of bio-based solvents contributes to offer elegant routes for the recycling of homogeneous catalysts. The case of glycerol and choline chloride as solvent will be particularly examined [3].

References
1. A. Corma, S. Iborra, A.Velty, *Chem. Rev*. **2007**, 107, *2411-2502*.
2. S. Van de Vyver, J. Geboers, P. A. Jacobs, B. F. Sels, *ChemCatChem* **2011**, 3(1), *82-94*.
3. Y. Gu, F. Jérôme, *Green Chem*., **2010**, 7, *1127-1138.*

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