

Research Topic for the ParisTech/CSC PhD Program

Subfield: Chemistry and Materials Science

ParisTech School: Chimie ParisTech

Title: Tandem Catalysis of Polyureas and Polyurethanes: A New Modular Approach to Polypeptide Analogues

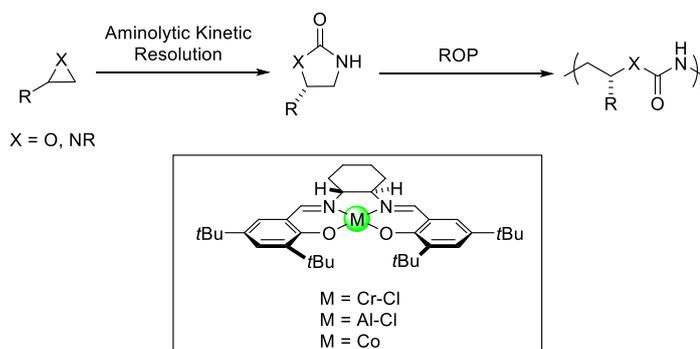
Advisor(s): Dr. Carine Robert (carine.robert@chimie-paristech.fr) / Prof. Christophe Thomas (christophe.thomas@chimie-paristech.fr), <http://ircp.cnrs.fr/spip.php?article172>

Short description of possible research topics for a PhD:

Tandem catalysis is one of the strategies used by Nature for building macromolecules. Living organisms generally synthesize macromolecules by *in vivo* enzyme-catalyzed chain growth polymerization reactions using activated monomers that have been formed within cells during complex metabolic processes.¹ However, these biological processes rely on highly complex biocatalysts thus limiting their industrial applications.

In the same biomimetic spirit, we want to initiate a research effort to synthesize **biodegradable** polymers² via tandem **catalytic transformations**, where “activated” monomers are synthesized from raw materials (in one or more steps) and subsequently (co)polymerized. The objectives for this are clear: not only can a reduction in workload, waste and energy consumption be achieved, but also the synthesis of complex products that are otherwise difficult to obtain (*e.g.*, because of thermodynamic hurdles) comes within reach. In other words, the combination of chemistries may allow the direct synthesis of macromolecules with high structural complexity.

Therefore we want to direct investigative efforts toward the synthesis of new **renewable monomers** and the subsequent catalytic conversion of these monomers into their corresponding polymers.³ The general and challenging idea of the present project is to use a tandem procedure of combining synthesis of new biomass derived monomers with subsequent polymerization by well-defined molecular or silica-supported metal-based catalysts, aiming at novel polymeric materials.



Scheme 1. Tandem synthesis of aliphatic polyureas and polyurethanes

Required background of the student: Organic Chemistry, Polymer Chemistry, Catalysis

A list of 5 (max.) representative publications of the group:

1. C. Robert, F. de Montigny, C. M. Thomas, *Nature Communications*, **2011**, DOI: 10.1038/ncomms1596.
2. C. M. Thomas, J.-F. Lutz, *Angewandte Chemie International Edition*, **2011**, 50, 9244-9246.
3. J. Guo, P. Haquette, J. Martin, K. Salim, C. M. Thomas, *Angewandte Chemie International Edition* **2013**, 52, 13584-13587.