

Reductive depolymerization of waste plastics and lignin using molecular catalysts

Louis Monsigny, Elias Feghali, Jean Claude Berthet, Thibault Cantat

► **To cite this version:**

Louis Monsigny, Elias Feghali, Jean Claude Berthet, Thibault Cantat. Reductive depolymerization of waste plastics and lignin using molecular catalysts. IsySyCat 2017 (International Symposium on Synthesis and Catalysis), Sep 2017, Evora, Portugal. cea-02340976

HAL Id: cea-02340976

<https://hal-cea.archives-ouvertes.fr/cea-02340976>

Submitted on 31 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Reductive depolymerization of waste plastics and lignin using molecular catalysts

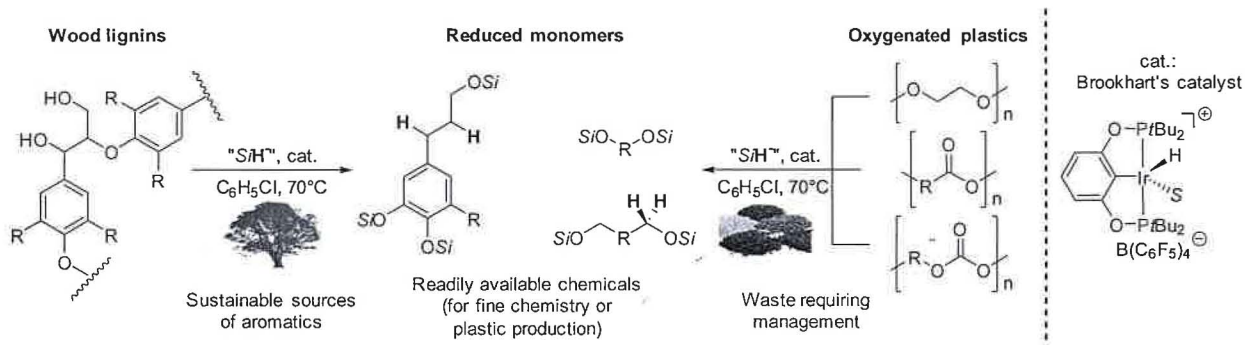
Monsigny L.,^a Feghali E.,^a Berthet J.-C.,^a Cantat T.^a

^a NIMBE, CEA, CNRS, Université Paris-Saclay, 91191 Gif-sur-Yvette, France

Email: louis.monsigny@cea.fr

Plastics are ubiquitous in our modern society. Mainly due to their lightness, their ease to be molded and their low costs, these polymers have forced their use in various applications such as electronics, packaging, medicine, etc. It is estimated that 4-6 % of the annual production of fossil resources are used to supply the 322 millions tons of plastics required worldwide.¹ Main recycling processes of these materials do not meet sustainable criteria since they are based on incineration and landfilling and the latter causes irreversible contamination of the oceans, the soils and the fauna leading to an increasing concern in the population.

To circumvent these ecological issues, the most promising approaches consist in decoupling plastics from fossils feedstocks by producing biosourced monomers and to improve recycling at the same time as to reduce losses of organic matter.² In this context, we recently developed an efficient strategy for the reductive depolymerization of oxygenated polymers such as some plastics and lignin to afford pure compounds.³ This method involves the hydrosilylation of oxygenated polymers under homogeneous catalytic conditions with tris(pentafluorophenyl)borane $B(C_6F_5)_3$. Based on this approach, we search for novel metal catalysts able to hydrosilylate strong C–O bonds and that would be more stable and selective than $B(C_6F_5)_3$ (**Scheme 1**).



Scheme 1: Catalytic hydrosilylation of wood lignins (left) and oxygenated plastics (right) with iridium(III) complex.

We found that Brookhart's iridium(III) complex supported by pincer ligands⁴ is very efficient catalyst for the reduction in homogeneous conditions of model compounds and natural or manufactured polymers. This complex enables the convergent depolymerization of lignin samples from various plant species⁵ as well as polycarbonates or polyesters,⁶ under mild conditions (<80 °C, 0.3-3 %mol). The reactivity and the stability of this new catalytic system and its role in the reduction of C–O bonds will be presented.

Acknowledgements: For support of this work, we acknowledge CEA, CNRS and ERC (Starting Grant Agreement n.336467)

References:

1. PlasticsEurope: Plastics The Facts 2016
2. World Economic Forum, Ellen MacArthur Foundation, The New Plastics Economy – Catalysing Action, 2017
3. Feghali E.; Cantat T., *Chem. Commun.*, **2014**, 50, 862. b) Feghali E.; Carrot G.; Thuéry P.; Genre C.; Cantat T., *Energy Environ. Sci.*, **2015**, 8, 2734. c) Feghali E.; Cantat T., *ChemSusChem*, **2015**, 8, 980.
4. Yang J.; Brookhart M.; *J. Am. Chem. Soc.*, **2007**, 129, 12656
5. Monsigny L.; Feghali E.; Berthet J.-C.; Cantat T., manuscript submitted in Green Chemistry.
6. Monsigny L.; Berthet J.-C.; Cantat T., manuscript in preparation.