Ecole Doctorale - 104
Sciences de la Matière, du Rayonnement et de l'Environnement

EDSMRE

UNIVERSITY: Lille, Faculty of Sciences and Technologies

Scientific field: Chemistry, Environment

Title of the thesis: Valorization of Plastic Wastes for Innovative Materials - VALOPLAST

Supervisor(s): Yohan Champouret, Marc Visseaux

Laboratory: Unité de Catalyse et Chimie du Solide, UCCS, UMR 8181

Related research project (international/national/regional): national

Expected/obtained funding: University of Lille

ABSTRACT

The objective of the VALOPLAST project is to upgrade **polyolefin wastes** (PE polyethylene and PP polypropylene) to offer them a **second life** in an eco-responsible context. A large part of this waste is currently not recovered and contributes to environmental pollution by plastics.[1] Indeed, it is not possible to produce a homogeneous material with exploitable properties, to date, because PP and PE do not mix efficiently.[2] Therefore, a challenge to be met is to use ***compatibilizing agents***, toward each PE and PP phase, to produce homogeneous blends from these plastic wastes. Such compatibilizing agents are macromolecular objects that must display multi-block microstructure to be efficient, whose range of possibilities offered by the synthetic macromolecular chemistry is very limited to date.[3] The strategy for this project is to use the long-standing expertise of the MOCAH team (UCCS lab, Lille) in this field.[4] By using catalysts developed in the team, already well proven and very versatile with regard to conjugated dienes, our ambition is to access, before and after a stage of hydrogenation, new ranges of macromolecular materials that are particularly well suited to this role of compatibilizing agent. In a comprehensive and complementary approach, the CoNEx team (Lamcube, Centrale Lille, co-partner) will carry out mechanical tests and microstructural studies in order to corroborate the nature of the compatibilizing agent required *vs.* PE and PP phases and evaluate the mechanical properties of the obtained mixtures against those of the original PE and PP materials.

The PhD student to be recruited must therefore have a generalist profile: he or she must have skills in macromolecular synthetic chemistry, a good background in catalysis, and knowledge of physics and mechanics.

[1] (a) "The new plastics economy: Rethinking the future of plastics" (Ellen MacArthur Foundation, 2016); https://www.ellenmacarthurfoundation.org/ https://www.ellenmacarthurfoundation.org/publications/the-new-plasticseconomy-rethinking-the-future-of-plastics. (b) J. R. Jambeck *et al*. "Plastic waste inputs from land into the ocean" *Science* **2015**, *347*, 768.

[2] A. Graziano *et al*. "Review on modification strategies of polyethylene/polypropylene immiscible thermoplastic polymer blends for enhancing their mechanical behavior" *J. Elastomers Plast.* **2019**, *51*, 291.

[3] (a) J.W. The *et al.* "A review of polyethylene–polypropylene blends and their compatibilization" *Adv. Polym. Tech.* **1994**, 13, 1. (b) J.M. Eagan *et al.* "Combining polyethylene and polypropylene: Enhanced performance with PE/iPP multiblock polymers" *Science* **2017**, *355*, 814.

[4] (a) T. Chenal, M. Visseaux "Combining Polyethylene CCG and Stereoregular Isoprene Polymerization: First Synthesis of Poly(ethylene)-b-(*trans*-isoprene) by Neodymium Catalyzed Sequenced Copolymerization" *Macromolecules* **2012**, *45,* 5718. (b) A. Valente, G. Stoclet, F. Bonnet, A. Mortreux, M. Visseaux, P. Zinck "Isoprene- Styrene Chain Shuttling Copolymerization Mediated by a Lanthanide Half- Sandwich Complex and a Lanthanidocene: Straightforward Access to a New Type of Thermoplastic Elastomers" *Angew. Chem. Int. Ed.* **2014**, *53*, 4638. (c) S. Georges, O.H. Hashmi, M. Bria, P. Zinck, Y. Champouret, M. Visseaux "Efficient One-Pot Synthesis of End-Functionalized *trans*-Stereoregular Polydiene Macromonomers" *Macromolecules*, **2019**, *52*, 1210.

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Planed recruitment date: October 2020

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