

Request for Knowledge Partners (22/04/2021)

Project title: Lignin oil-based polyols for polyurethane applications

Acronym: LIBERTY

Project ID	
Type	ICON
Period	2-3 years
Starting date	1 April 2022
Total project budget	To be determined
Subsidy percentage	according to SBO and O&O regulations
Current industrial partners	confidential
Catalisti contact	Isabelle Monnaie (imonnaie@catalisti.be)

Project description

Introduction

Polyurethanes (PU) are a versatile class of polymers and can yield a wide range of products including rigid and flexible PU foams, adhesives, sealants, or coatings. A typical PU formulation includes one (or several) polyol(s), an isocyanate and additionally some additives. Traditionally, these building blocks are fossil-based. Yet, there is a strong market demand for greener PU with improved sustainability and environmental characteristics. In this context, the use of lignin, a renewable aromatic polyol, has several advantages: (1) the presence of hydroxyl functionalities to react towards isocyanates, (2) the lignin network structure can improve the mechanical properties and thermal stability, and (3) the natural properties can contribute to higher moisture and flame resistance of PU foams.

Several studies have already reported the direct incorporation of lignin (Kraft, Organosolv) in PU materials. However, despite the long history of lignin PU synthesis, several issues are still preventing the more widespread integration of lignin in PU products. The synthetic challenges for designing lignin PU are well known and are generally attributed to (1) the low solubility of lignin (in solvents or with the other PU precursors), resulting in its poor incorporation into the polymer matrix, in low reactivity with the co-reactants, and the impossibility to use common organic solvents, (2) the high molecular weight of lignin, (3) its high polydispersity, which leads to inconsistent performance, reactivities and solubilities, (4) its sulphur content that can generate odour problems and yellowing of final products, and (5) lignin's dark colour that prevents its use in certain applications including coatings.

In order to overcome these limitations and improve the lignin content in PU products, the use of depolymerised lignin (so called "lignin oils") is a promising option, because the lower molecular weight of the depolymerised lignin building blocks could allow a better reactivity and miscibility, thus enhancing the applicability of lignin and its derivatives as alternative to the fossil-based PU precursors. The crucial role of the lignin oil's molecular structure and functionality on the physical properties of the resulting PU materials has not been investigated so far and still needs to be fully elucidated in order to enable the rational design of a wide range of sustainable PU products such as foams, adhesives or coatings.

Goals

The goal of LIBERTY is:

- to develop lignin fractions (bio-polyols) produced by metal catalysed depolymerisation, fractionated, formulated, and possibly chemically modified, in order to achieve increased reactivity with isocyanates;
- to design a new generation of PU materials derived from sustainable polyols for different PU applications including two component insulation products, adhesives, sealants and one component foams;

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- to gain insight on the structure-activity relationship of the lignin fractions on the performance of the PU materials and fine-tuning of those lignin fractions to optimise performance.

Beyond increasing the renewable content in the PU products (and the important lower carbon footprint associated with it), the project will focus on designing innovative biopolymers with unique and tunable properties by leveraging on the unique molecular structures of lignin and lignin oil-based polyols. Overall, this project will further contribute to the establishment of a new lignin value chain in Flanders and to the development of a bio-circular economy, in accordance with the Catalisti innovation roadmap.

Request

The consortium currently consists of a global producer of PU insulation materials and a global producer of PU adhesives, sealants and foams.

With this Request for Partners, we would like to invite universities/knowledge institutes that have expertise, technology or knowledge relevant to the project to respond to this request. **To reach the project goals, the consortium is particularly searching for the following (non-limitative) expertise:**

- fractionation of lignocellulose feedstocks, controlled depolymerisation of extracted lignin and delivery of (molecularly) well-characterised and tunable lignin oils at sufficient scale;
- analysis and chemical modifications of the lignin oils to further tune reactivity for PU synthesis.

How to reply to this request

Please send your **proposal by email before 6 May 2021 (12h00)** to Catalisti, **exclusively via your association representative** (see contact list below). An application (2-3 pages without attachments) should contain at least the following items:

1. Organisation and research group
2. Name and contact details of person submitting the proposal
3. Name and contact details of person(s) who will perform the actual tasks (if different from submitting person)
4. A proposal of your role in the project: for which expertise/assignments described above do you apply?

Provide a concrete proposal on:

- how you want to contribute to the required expertise/assignments and how you want to solve the (research) problem described above
- how this fits in the (long-term) ambition of the research group/knowledge institute

If you consider your contribution to fit within fundamental basic research (SBO), please provide argumentation.

5. A description of your expertise/track record/experience in the specific topic of this RfP, for which you are applying (at the 3 organisational levels as mentioned above, i.e. for the organisation and/or research group, for the person submitting the proposal, as well as for the executing person(s)) (preferably give the resumes of submitting and executing persons attached)
6. A list of relevant funded projects (Catalisti, VLAIO, EU, ...) where you were a coordinator or partner
7. A commitment to prepare a full project proposal by 20 August 2021 together with the other project partners.

Please contact your association representative for more details on how to write your application.

Contact List

- KU Leuven: Bert Lagrain (bert.lagrain@kuleuven.be);
- UAntwerpen: Ann Aerts (annfb.aerts@uantwerpen.be);
- UHasselt: Lieve De Doncker (lieve.dedoncker@uhasselt.be);
- UGent: Elisabeth Delbeke (elisabeth.delbeke@ugent.be);
- VUB: Philippe Westbroek (philippe.westbroek@vub.ac.be);

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- Centexbel: Isabel De Schrijver (ids@centexbel.be);
- VITO: Brecht Vanlerberghe (brecht.vanlerberghe@vito.be);
- BBEU: Hendrik Waegeman (hendrik.waegeman@bbeu.org);
- Sirris: Benjamin Vandeputte (benjamin.vandeputte@sirris.be);
- IMEC: Kris Van De Voorde (kris.vandevoorde@imec.be);
- VKI: Peter Simkens (peter.simkens@vki.ac.be).

Evaluation

The industrial partners, together with Catalisti, will review all proposals obtained before the deadline mentioned above. The industrial partners will make a selection of the best proposals based on the following criteria:

- your expertise in the requested expertise domain (5pt)
- your experience in carrying out similar assignments (3pt)
- your experience in other relevant funded projects as a coordinator or partner (3pt)
- complementarity with the other executing project partners (4pt)

After submission of your proposal, you can be contacted by telephone or invited to an online or live meeting (if this is deemed necessary by the industrial partners) to further elaborate your offer. *Please note that the selection will be made primarily based on your written proposal, so be complete and thorough, without anticipating on a further elaboration of your proposal.*

The final decision will be communicated typically within 2 weeks after the deadline mentioned above, but could take longer depending on the number of proposals and selection of a balanced project consortium.

Contact

Please contact Isabelle Monnaie (imonnaie@catalisti.be, +32 471 506 833) if you have any questions concerning this RfP or the Catalisti procedures in general.

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