Request for knowledge partners (June 29th, 2018)

Project title: **E**fficient **A**ffinity **S**eparat**i**ons for **CHEM**ical applications

Acronym: EASiCHEM

Project ID	
Type	Cluster SBO (cSBO)
Periode	4 years
Starting date	TBD
Total project budget (€)	± 2.500.000 €
Total man months	TBD
Subsidy percentage	According to SBO regulations
Amount of subsidy (€)	100%
Coordinator	VITO
Industrial partners	Current partners not disclosed at the moment
Executing Partners	TBD

Project description

Introduction

In general, energy-efficient and highly-selective separation processes are very important for a more sustainable chemistry, as they can replace part of the huge amount of traditional, mainly thermal separations used in industry today. However, more specifically, many chemical industry sectors are nowadays confronted with very challenging liquid separations at the molecular scale. The mixtures involved often contain different molecules with similar physical properties (size, boiling point, …) making separation extremely difficult. Examples are separation of fatty acid mixtures for removal of unhealthy saturated and/or trans fats, or fractionation of depolymerized lignin streams for more directed and optimal biopolymer formation. In modern chemistry, more and more based on bio-based feedstocks, and more and more targeted to complex highly-tailored chemical structures, the number of these demanding separations increases substantially.

These separation challenges would benefit from efficient affinity separations, allowing molecules to be separated on the basis of, ideally, small affinity differences. The most traditional affinity separation technology is solvent extraction. Here, the separation requires a sufficient difference in solvent-

solute affinity, a relative high solvent volume, and an extra separation step recuperating the product out of the extracting solvent. An example allowing a finer affinity separation is chromatography, where small differences in affinity between the molecules and the tailored chromatography stationary phase, lead to elution differences from the column. Although successful in different situations, chromatography is only used in specific, merely high-value cases, as huge amount of solvents are required, and up-scaling to large scale is difficult.

Goal

This project aims at developing more efficient, and more sustainable affinity separation technologies. Preferably, they should be:

- At least as efficient as chromatography;
- Flexibly tuneable to the separation at hand;
- Allowing unlimited, easy up-scaling;
- Allowing continuous processing;
- Allowing coupling to reactors;
- With a low to zero use of extra resources (as solvents).

An example: a decade ago, VITO – in collaboration with the University of Antwerp – developed a new method for flexible chemical functionalization (grafting) of nanoporous ceramic membranes. In the meanwhile, it is proved that these FunMem membranes show very good performance in a wide variety of separations in water- and solvent-based streams. They do not only show size-exclusion behaviour, but reveal also clear signs of affinity separations based on differences in solute-membrane affinities, partly tuned by the solvent in the mixture (similar to chromatography). FunMem can be flexibly tailored to the separation, and as all membrane technologies, are easily up-scalable, allow for continuous processing, and also allow for coupling to a reactor opening further opportunities for reaction optimization. Moreover, more recently, FunMem have also shown interesting behaviour in a new membrane-based extraction process. Surprisingly, the transport in this innovative membrane-contactor process is mainly driven by solute-membrane affinity, and not by solute-extractant affinity as in more traditional extractions. Both affinity separation technologies, are envisioned to have a broad application potential for a wide range of difficult liquid separations.

The proposed cluster SBO project is intended to develop more valuable affinity separation technologies fulfilling the above-mentioned goals. The project will determine the potential and the limitations of the new affinity separation processes. Benchmarking to conventional liquid-liquid extraction and/or chromatography will be performed. Hereto, all processes will be applied to the same industrially-relevant separation cases, suggested by an extensive industrial advisory board. The applications tested will encompass a broad variety of economically-interesting separation problems, encountered in different sectors of the chemical industry. If possible, the experimental data

obtained will be used to model the affinity separation processes, and get a thorough fundamental understanding of the (differences in) transport and separation behaviour. Vice-versa, modelling can steer more efficient experimentation. The final goal is to obtain a first good techno-economic evaluation, allowing also an efficient comparison of the different technologies developed.

Expertise

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:

- Advanced chromatography, testing and fundamental understanding, potential to test new chromatography materials;
- Modeling of advanced membrane separations for nanoporous membranes;
- Advanced material characterization tools, allowing the study of affinity interactions on different materials;
- Advanced membrane contactor processes, preferably also with ceramic membranes;
- Other tunable, affinity-based separation methods (such as reactive extraction or reactive distillation).

This list of tasks, however, is not limiting, so that other expertise deemed relevant to reach the project goals can also be offered.

How to reply to this request

Please send an e-mail before **July, 27th, 2018,** 12:00 PM (noon) to your association representative (see contacts listed below), and describe your organisation or research group, the technology, expertise or solution you can offer and your experience:

- 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);
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- VITO: Karolien Vanbroekhoven (karolien.vanbroekhoven@vito.be);
- BBEU: Brecht Vanlerberghe (brecht.vanlerberghe@bbeu.org);
- Other: Luc Van Ginneken (lvanginneken@catalisti.be).

Evaluation

Catalisti, together with the initiating coordinator, will review all responses obtained and will make a selection of the best (complementary) proposals in line with the scientific approach/goals and with the needs and valorization perspectives of the main industrial partners. After submission of your offer, you can be contacted by telephone or invited to a live meeting (if this is deemed necessary by Catalisti and the coordinator) to further elaborate your offer. Please contact Luc Van Ginneken (lvanginneken@catalisti.be; (+32)(0)477/97.99.47) or your association representative if you have any questions concerning this RFP.

END OF RFP