

2 PhD fellowships on chemical control of hydrodynamic mixing

Context

The Marie Skłodowska-Curie Innovative Training Network (ITN) **CoPerMix** offers two PhD positions to work in The Nonlinear Physical Chemistry Unit (NLPC) of the Université libre de Bruxelles on the topic of chemical control of hydrodynamic mixing. CoPerMix is a consortium of high profile universities, research institutions and companies located in France, Spain, Germany, Switzerland, Belgium, Italy and the UK, and will train 15 PhD students in total (Early Stage Researcher, ESR). The objective of the network is to develop a unified vision, numerical tools, and experimental techniques allowing the description and the quantification of mixing processes in complex flows, such as turbulent atmospheric or oceanic flows and those encountered in geological, granular and biological media. In this context, research performed at NLPC focuses on the experimental and theoretical study of spatio-temporal patterns and dynamics emerging from the coupling between chemical reactions and hydrodynamic flows.

For more information, see: <https://www.copermix-itn.eu/>

Research to be performed

The specific objectives of the PhD positions at the NLPC are:

PhD1: Experimental and theoretical study of the impact of advective mixing on the yield of an $A+B \rightarrow C$ reaction. The objective is to understand by combined experimental and theoretical analysis how flow conditions can influence the mixing of reactive species in simple bimolecular $A+B \rightarrow C$ fronts. The ESR will first study how the properties of $A+B \rightarrow C$ fronts can be modulated in a radial flow in empty horizontal Hele-Shaw cells. In particular, experiments and modeling will analyze the influence of dispersion and possible buoyancy- or viscosity-driven mixing effects within the gap of the cell on scalings for the location and width of the front as well as for the reaction rate. In a second step, the situation of quasi-2D porous media will be considered by filling the Hele-Shaw cell with obstacles in order to see how geometric constraints affect the mixing scaling laws obtained in an empty cell. The more complicated 3D porous medium case will finally be tackled by studying the properties for $A+B \rightarrow C$ fronts in 3D packing of beads with index matching techniques. Expertise in experimental fluid dynamics is an asset.

PhD2: Chemical control of interfacial hydrodynamic instabilities. The objective is to investigate numerically and theoretically the conditions in which a simple bimolecular $A+B \rightarrow C$ reaction can actively tune mixing by changing the spatio-temporal properties of hydrodynamic convective instabilities triggered by changes in density, in viscosity or in permeability. The PhD student will compare control methods in reactive and non-reactive cases by performing a theoretical analysis of the stabilizing or destabilizing effects of the reaction on the hydrodynamic instabilities considered. The numerical approach will consist in integrating numerically reaction-diffusion-convection models of convective fingering to analyze the nonlinear reactive dynamics. In parallel, linear stability analyses of base state

density, viscosity or permeability profiles affected by the reaction will be developed. Expertise in simulations of hydrodynamic instabilities is an asset.

Eligibility criteria

At the time of recruitment, the applicant must not have resided or carried out his/her main activity (work, studies, etc.) in the country of the host organization for more than 12 months in the 3 years immediately prior to his/her recruitment. Moreover, the applicant must fulfill the requirements defined for Early Stage Researchers (ESRs): ESRs are researchers who, at the time of recruitment, have NOT yet been awarded the doctorate degree and are in the first 4 years (full-time equivalent) of his/her research career.

Required Qualifications

Master in Chemistry, Physics, Mathematics, Engineering or related fields. Good oral and written communication skills in English to work in a multidisciplinary team environment. Knowledge and skills in quantitative research. Skills in programming and scientific software.

Terms of employment

The successful candidates will receive an attractive salary in accordance with the EU-ITN regulations for early stage researchers. The exact salary will be confirmed upon appointment and is dependent on the country correction factor (to allow for the difference in cost of living in different EU Member States). The salary includes a living allowance, a mobility allowance and a family allowance (if married). The guaranteed PhD funding is for 36 months.

The target starting date is October 1st, 2021.

Application Procedure

The application, in English, must be submitted electronically via email to adewit@ulb.ac.be and must include:

- Cover letter explaining your motivation to apply and your key qualities relevant for the position opened.
- Up-to-date curriculum vitae.
- Copies of your diploma and transcripts of records (BSc and MSc)
- Contact information of two academic references.

Deadline to apply: May 28th, 2021.

Contact Person

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