MIGRATE

MIniaturized Gas flow foR Applications with enhanced Thermal Effects

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 643095

MIGRATE (Research and training network on **MI**niaturized **G**as flow fo**R** **A**pplications with enhanced **T**hermal **E**ffects) is planned as a multi-partner Innovative Training Network (ETN – European Training Network), assessing research and applications for thermal aspects of gas microflows. The network consists of 10 beneficiaries and 7 associate partners, spread all over Europe. This unique combination of university research, SME and world leading industrial stakeholders will contribute in a synergetic way to the increase of knowledge about micro scale gas flow heat transfer problems as well as to industrial applications of highly efficient miniaturized devices. Within MIGRATE, a number of Early Stage Researcher (ESR) projects will cover different aspects of enhanced heat transfer and thermal effects in gases, spanning from modelling of heat transfer processes and devices, development and characterization of sensors and measurement systems for heat transfer in gas flows as well as thermally driven micro gas separators to micro-scale devices for enhanced and efficient heat recovery in automotive, aeronautics and energy generation.
The ESRs recruited for the network will undergo training in at least three different locations. Additionally, short stays can be arranged at beneficiaries and associate sites. Moreover, annual network wide workshops and summer schools will ensure that each researcher receives exposure to, and benefits from, the full expertise of the Network.

More information can be obtained from www.migrate2015.eu.

Within the MIGRATE network an

E S R Position

is offered at INSA Toulouse, France, with the topic

Micro Molecular Tagging Thermometry - µMTT

Ref. N°: MIGRATE-ESR 5

The position includes secondments at

Institute of Mechanics, Bulgarian Academy of Sciences (IMECHBAS), Sofia, Bulgaria (5 Months)

Alcatel – Lucent Bell Laboratories, Dublin, Ireland (5 Months)

Short stays at University of Limerick, Ireland and Karlsruhe Institute of Technology, Germany are also foreseen.

Main goal:
Implementation of a molecular tagging technique for the measurement of temperature fields in gas microflows. An innovative experimental setup will be developed, validated on benchmark cases and used for analyzing more complex non-isothermal gas flows.

Duration: 3 years

Expected starting date: 1-Mar-2016

Application deadline: **15-Jan-2016**

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Detailed description of the project:

Gas flows in microsystems find nowadays more and more industrials applications in numerous fields such as environment, aerospace engineering, vacuum technology... These applications require fluidic microsystems in which the small dimensions and/or the low pressure lead to local thermodynamic disequilibrium. For example, it can result in a temperature-jump between the gas and the wall.
In the past ten years, a number of theoretical and numerical studies have been aimed at modeling gas flow and heat transfer at microscale, but there is still a crucial lack of experimental data in this field.
The main experimental recent developments have concerned velocity and pressure fields measurements. The experimental analysis of the temperature distributions even in simple geometrical configurations remains an issue because it cannot be easily done by conventional methods due to the small size scale involved.
The goal of the present PhD project is to develop a specific experimental setup based on molecular tagging for temperature measurement in mini- and microsystems. The technique exploits the specific properties of some luminescent gaseous molecules which depend on the temperature. It has already been validated in liquid flows, but its implementation in gas flows, in particular at the microscale or in rarefied regimes, remains a challenging project.
This project is a collaboration between 3 partners:

- The National Institute of Applied Sciences (INSA), Toulouse, France (www.insa-toulouse.fr/en), which is specialized in experimental analysis of gas microflows and has already developed an original setup for molecular tagging velocimetry.
- IMech-BAS, Sofia, Bulgaria (http://www.imbm.bas.bg/), specialized in molecular simulation of gas microflows.
- Alcatel – Lucent Bell Laboratories, Dublin, Ireland (https://www.alcatel-lucent.com/ie/directory), which research activities are focused on cooling of high performance electronics.

The Early Stage Researcher will spend the majority of his/her time at INSA Toulouse, with 5-month secondments at IMech-BAS and at Alcatel – Lucent Bell Laboratories.

Expected time schedule

ESR n°5	Year 1		Year 2	Year 3	
	1st Stay	2nd Stay	3rd Stay	4th Stay	5th Stay
Location	**INSA**	**IMech-BAS**	**INSA**	**BELL**	**INSA**

1st stay - INSA (9 months): Literature review on experimental techniques to analyse gas microflows. Training on molecular tagging techniques. Adaptation of the existing molecular tagging velocimetry setup for using it for temperature fields measurements. Preliminary experimental tests in simple isothermal configurations.

2nd stay - IMech-BAS (5 months): Numerical analysis, by Direct Simulation Monte-Carlo (DSMC) method, of the tests performed on the experimental setup to take into account diffusion effects for the accurate treatment of the experimental data.

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3rd stay - INSA (10 months): Detailed experimental analysis of luminescent properties of the tracer gases. Extensive experimental campaign in complex configurations with temperature gradients.

4th stay - Alcatel – Lucent Bell Laboratories (5 months): Analysis of possible developments of the technique on specific cases in industrial context.

5th stay - INSA (7 months): Complementary experiments in Toulouse, in-depth analysis on MTT limits at microscale (spatial resolution, pressure and temperature ranges of applicability…). Writing of the PhD thesis.

Short visit(s): In addition, two Short Visits of a few weeks each will be scheduled, one at the University of Limerick, Ireland, for comparisons with other thermometry techniques, and the other one at Karlsruhe Institute of Technology (www.kit.edu/english), Germany, for training on microfabrication techniques and design of experimental cells equipped with specific thermal control.

Requirements

This is a challenging and highly rewarding course of study and therefore the successful candidate will need to have the following qualifications:

- Master-level (5 years) degree in Engineering or Physics or Applied Mathematics with high standard results;
- very good background in fluid mechanics and heat transfer
- excellent communication skills and written/verbal knowledge of the English language;
- high autonomy and adaptability skills;
- if the candidate has some experience in microfluidics and/or in experimental techniques adapted to fluid flows, as well as some knowledge on lasers, this would be a benefit.

Financial information / Salary

Annual gross salary including employer's contribution to social security: 41,425 €
Annual mobility allowance: 7,200 € (researcher without family obligations) – 13,200 € (researcher with family obligations).

Contacts:

For further information please contact either Prof. Stéphane Colin: colin@insa-toulouse.fr
or Dr. Christine Barrot : christine.barrot@insa-toulouse.fr

Application procedure:

Applications for this position have to include a detailed Curriculum Vitae with the contact details of three referees, a covering letter, attestation of the diploma / master degree and last transcript of records and they should be sent, using the reference number in the subject line via e-mail, either to:

Prof. Stéphane Colin: colin@insa-toulouse.fr
Dr. Christine Barrot : christine.barrot@insa-toulouse.fr

Deadline: 15-01-2016

Eligibility of your application can be checked here: www.migrate2015.eu/