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 a joint

E S R Position

is offered at IUSTI Laboratory of the Aix Marseille University, Marseille, France and Institute of Mechanics, Bulgarian Academy of Sciences (IMECHBAS), Sofia, Bulgaria with the topic

Thermal Gas Separation

Ref. N°: MIGRATE-ESR 8

The position includes secondment at

IN'AIR Solutions, Strasbourg, France (6 months)

Short stays at Karlsruhe Institute of Technology (KIT), Germany; at ATG, The Netherlands and at Strathclyde University are also foreseen.

Main goal: Experimental investigation of the gas separation phenomenon in a microchannel under temperature gradient applied to the channel's surface. Development of the mathematical models allowing the simulation of the gas separation induced by the temperature gradients.

Duration: 3 years

Expected starting date: 1-September-2016

Application deadline: **1-June-2016**

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Detailed description of the project:

The experimental work on flows in micro channels has mainly been based on the Constant Volume and the Droplet Tracking methods and the flow rates through channels of various cross-sections have been measured. In most of these studies only the pressure driven single gas flows are analyzed. However, the knowledge on gas mixture behavior in micro devices is indispensible for the further development of gas micro devices, like micro sensors and micro gas analyzers. Therefore, there is still a lack of experimental data on the thermal behavior of gas mixtures, in particular in separation micro devices.

Goal of the present PhD project is to investigate experimentally the properties of gas mixture flows through micro channels submitted to a temperature gradient. Main efforts will be focused on the phenomena of gas separation induced by a temperature gradient applied to the channel's surface. A new experimental setup will be developed for the measurements of the gas separations. Several configurations will be analyzed and compared, taking into account the technical possibilities of microfabrication. A mathematical model will be developed to simulate the separation of the binary or ternary gas mixtures in micro channels.

This project is a collaboration between 3 partners: the Aix Marseille University (AMU), Marseille, France (http://www.univ-amu.fr/), involved in the experimental study of the temperature gradient induced gas separation; the Institute of Mechanics, Bulgarian Academy of Sciences (IMECHBAS), Sofia, Bulgaria, (http://www.imbm.bas.bg/), which is specialized in the numerical modelling of the single gas and gas mixture microflows; and IN'AIR Solutions, Strasbourg, France, (http://www.inairsolutions.fr/en/), a start-up specialized in detection and analysis of the pollutions present either in the products or in the air. The researcher will spend the majority of his/her time at the Aix Marseille University and at Institute of Mechanics, with a 6-month secondment at IN'AIR Solutions. At the end of the project, the ESR will receive a PhD double diploma delivered by both the Aix Marseille University and the Institute of Mechanics, Bulgarian Academy of Sciences. Short visits at Karlsruhe Institute of Technology (KIT) (www.kit.edu/english), Germany, at ATG Europe BV (http://www.atg-europe.com/), and at the Strathclyde University are foreseen.

Expected time schedule

ESR n°8	Year 1		Year 2		Year 3
	1st Stay	2nd Stay	3rd Stay	4th Stay	5th Stay
Location	AMU	IMECH	INAIR	IMECH	AMU

1st stay: AMU (6 months): Bibliography on the behavior on gas mixture flows induced by pressure and temperature gradients. Development of an experimental setup for the analysis of mixture flows inside a microsystem submitted to a temperature gradient. Analysis of different technical configurations and technical possibilities of microfabrication (advantages, disadvantages, cost,

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delays). Short visit to Karlsruhe Institute of Technology (KIT) (www.kit.edu/english), Germany, to design a micro device with different surface's nature for experimental study of thermally induced gas separation. Mounting of a new experimental setup.

2nd stay: IMECHBAS (6 months): Training on basic knowledge in kinetic theory, modelling of single gas flows and flows of a gas mixture in transitional regime using theDSMC method. Starting of mathematical model development, based on theDSMC method, for simulation of temperature and pressure gradient driven flows of a gas mixtures through micro channels.

3rd stay: IN'AIR Solutions (6 months): Experience in Industrial needs for gas mixture separation. Development of a micro gas chromatographic column concept.

4th stay: IMECHBAS (9 months): Numerical simulation of gas mixture behavior inside micro devices. Two geometrical configurations will be used: first the geometry of the experimental setup, second that of the micro gas chromatographic column. Validation of the numerical models. Application of a series of numerical simulations corresponding to possible experimental conditions.

5th stay: AMU (9 months): Measurement of gas mixture flow behavior for different compositions of gases and for different temperature gradients intensities. Comparison between experimental data and numerical simulations results.

Short visit(s): In addition, Short Visits of a few weeks each will be scheduled, at Karlsruhe Institute of Technology (www.kit.edu/english), Germany, for design and fabrication of the experimental microsystem setup, at ATG Europe (www.atg-europe.com), Netherlands, for specific numerical simulations in a private sector environment, at Strathclyde University (https://www.strath.ac.uk/) for the training on the numerical simulation of gas mixture behavior using the Discrete Velocity Method approach.

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 as well as in Fortran and/or C++ programming;
- 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 and computational techniques adapted to fluid flows, as well as in kinetic theory of gases, this would be a benefit.

Financial information / Salary

During the stay in France: Annual gross salary: 41,425 €

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Annual mobility allowance: 7,200 € (researcher without family obligations) – 13,200 € (researcher with family obligations).

During the stay in Bulgaria: Monthly gross salary: 2,223 €

Contacts:

For further information please contact either Irina Graur: irina.martin@univ-amu.fr
Pierre Perrier: pierre.perrier@univ-amu.fr (Aix Marseille University)

Stefan Stefanov stefanov@imbm.bas.bg (IMECHBAS)

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. Irina Graur: irina.martin@univ-amu.fr
or
Pierre Perrier: pierre.perrier@univ-amu.fr

Deadline: 01-06-2016

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