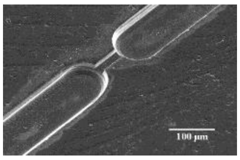


MIGRATE

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 INSA Toulouse, France and UTH Volos, Greece with the topic

Thermally Driven Vacuum Micro Pumps

Ref. N°: MIGRATE-ESR 6

The position includes secondment at

INFICON, Balzers, Liechtenstein

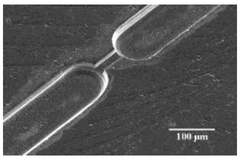
Short stays at different other beneficiaries or associated partners are also foreseen and/or may be possible by negotiation.

Main goal: Computational and experimental investigation of the performance characteristics of a multi-stage thermally driven micropump without any moving part (Knudsen pump) including the quantitative comparison and optimisation of various designs plus the fabrication and testing of a prototype to optimize efficiency and low energy consumption.

Duration: 3 years

Expected starting date: 1-Mar-2016

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



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Detailed description of the project:

Micro gas flow devices are employed in a wide range of fields ranging from gas analysis to vacuum technology. An alternative way to the classical approach on pumping has been developed by exploiting the specific characteristics of the thermal transpiration phenomenon, which allows, under rarefied conditions (at low pressure and/or in microscales), a fine control of a gas flow by just imposing local temperature gradients. This leads to the so-called Knudsen pumps that do not require any moving part. Typical Knudsen pumps use a periodic structure consisting of alternately arranged narrow and wide channels, with a specific temperature distribution. The control of this periodic temperature distribution and the integration of a series of narrow and wide channels present, however, several drawbacks and limitations.

The goal of the present PhD project is to investigate original alternative designs able to avoid these drawbacks and to fabricate a prototype of vacuum micropump with improved efficiency and reliability. Several configurations will be analysed and compared, taking into account the technical possibilities of microfabrication. The actuation will result either from longitudinal temperature gradients applied along microchannels with a specific shape (serpentine, convergent/divergent, …) or from transversal temperature gradients between two structured (ratchet-like) walls. The optimisation of the best design will be obtained by numerical simulations. A prototype will then be fabricated and tested.

This project is a collaboration between 3 partners: the University of Thessaly (UTH), Volos, Greece (www.mie.uth.gr) involved in numerical modelling of rarefied gas flows; the National Institute of Applied Sciences (INSA), Toulouse, France, (www.insa-toulouse.fr/en), which is specialised in experimental analysis of gas microflows; and INFICON, Balzers, Liechtenstein (www.inficon.com) which is an international leader company in vacuum processes. The researcher will spend the majority of his/her time at the University of Thessaly and at INSA Toulouse, with a 6-month secondment at INFICON. At the end of the project, the ESR will receive a PhD double diploma delivered by both the University of Thessaly and the National Institute of Applied Sciences from Toulouse.

Expected time schedule

ESR n°6	Year 1		Year 2		Year 3
	1st Stay	2nd Stay		3rd Stay	4th Stay
Location	**INSA**	**UTH**		**INFICON**	**INSA**

1st stay: INSA (6 months): Bibliography on thermally driven micropumps. Analysis of different technical configurations and technical possibilities of microfabrication (advantages, disadvantages, cost, delays). Comparison of longitudinal temperature gradient layouts (straight, serpentine, convergent-divergent, etc., channel micropumps) and transversal temperature gradient layout (ratchet micropump). Short visits at, and discussions with, LAAS laboratory in Toulouse specialised in microfabrication. Final choice of the configuration(s). Design and launch of microfabrication. Design of a new experimental setup or adaptation of an existing setup. Order of required components and materials.

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2nd stay: UTH (15 months): Training on computational kinetic theory and rarefied gas dynamics: Kinetic modelling and DSMC. Implementation of in-house kinetic codes solving rarefied gas flows in channels of various cross sections with longitudinal and transversal temperature gradients and integration of the kinetic data into a s/w tool to provide the performance characteristics of multistage Knudsen micropumps with the previously selected configuration(s).

3rd stay: INFICON (6 months): Industrial experience in manufacturing, inspection of vacuum and micro sensors.

4th stay: INSA (9 months): Experiments in Toulouse on the prototype. Comparison with numerical simulations. Writing of the PhD thesis.

Short visit(s): KIT and ATG: In addition, two Short Visits of a few weeks each will be scheduled, one at Karlsruhe Institute of Technology (www.kit.edu/english), Germany, for additional training on appropriate microfabrication techniques for vacuum microsystems design, and the other at ATG Europe (www.atg-europe.com), Netherlands, for specific numerical simulations in a private sector environment.

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

Annual gross salary: 41,425 € during stays in France and Liechtenstein; 34,596 during the stay in Greece.

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

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<u>Contacts:</u>

For further information please contact either Prof. Stéphane Colin: colin@insa-toulouse.fr
or Prof. Dimitris Valougeorgis: diva@mie.uth.gr

<u>Application procedure:</u>

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
or
Prof. Dimitris Valougeorgis: diva@mie.uth.gr

Deadline: 15-01-2016

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