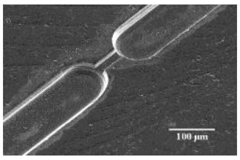


# MIGRATE

**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 **In'Air Solutions (INR)** with the topic

# Gas-Solid Surface Micro Separators - VOCs Trapping

Ref. N°: **MIGRATE-ESR 10**

The position includes secondments at

**ICPEES**

and

**Aix Marseille University (AMU)**

Short stays at different other beneficiaries such as University of Thessaly (UTH)-or associated may be possible by negotiation.

Main goal: **Development of an analytical microfluidic method able to adsorb benzene and its derivatives and to desorb them quantitatively and rapidly by heating**.

Duration: 22 months

Expected starting date: 01-01-2018

Application deadline: **15-12-2017**

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**<u>Detailed description of the project:</u>**

The development of ultra-portable, accurate and powerful analytical tools capable of monitoring the air pollutants in near real time is a challenge. Among pollutants, benzene is a major and harmful one of indoor air due to its high carcinogenic effect. French recommendations aim at limiting benzene concentrations in public buildings to 2 µg $m^{-3}$ (0.6 ppb) by 2018, helping to promote the development of new highly portable instruments or smart sensors.

In this context, ICPEES and INR recently reported the development and the optimization of a novel patented portable micro-GC based on photoionisation detection able to detect BTEX at ppb level (Nasreddine et al., 2015a). The device is very portable; its final weight does not exceed 4 kg with a very low consumption of carrier gas, ca. less than 3.0 mL $min^{-1}$. This new device operates according to two consecutive steps, sampling and analysis. The system is standalone, fully controlled by homemade software and exhibits a time resolution of 10 minutes.

In order to assess its analytical performance, the ICPEES/INR micro-GC was tested during a field campaign aiming at highlighting the temporal variations of various pollutants concentrations inside a newly built junior high school that follows the French thermal regulation of 2005 under the MERMAID project (Nasreddine et al., 2015b). The compact highly portable and low consumable micro-device has shown its ability to detect every variation of toluene concentration between 2 and 18 ppb in all tested conditions which makes it perfectly appropriated for indoor air monitoring over a long period. However, its current sensitivity does not permit to monitor atmospheric benzene or toluene concentration below 1 or 2 ppb.

The objective of this work is to support the developing of a microfluidic preconcentrator in order to improve the sensitivity of the current instrument and the better understanding and controlling of both adsorption and desorption.

The apparatus will operate in three different steps, i.e. the air sampling, the sampling transfer at a stable flow rate of a few mL $min^{-1}$ to the microfluidic preconcentrator where the molecules will be adsorbed and the injection by thermosdesorption into the column placed in a thermostatically controlled oven, and where the species are separated before being detected by the mini Photo Ionization Detector (PID).

Modeling will better characterize the flow through different configurations of preconcentrator microfluidic chips. Based on these new insights, changes in different microfluidic parts will be proposed, modeled and drawn. Once fabricated using microfabrication techniques, the preconcentrator will be then tested under controlled laboratory experimental conditions, i.e. accurate known gaseous BTEX concentrations at given flow rates, in order to determine the new analytical performances of the upgraded device.

The modeling part will be performed at AMU but supportive work could be done at University of Thessaly (UTH) where a preliminary modeling work was conducted. The development of the microfluidic preconcentrator and a part of experimental tests will be performed at INR, while the final analytical validation will be conducted at ICPEES.

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**Expected time schedule**

| ESR n°10 | **Year 1** | | | | | | | | | | | | **Year 2** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | 1st stay | | | | | | | | | | | | | 2nd stay | | | | | 3rd stay | | | |
| Location | INR | | | | | | | | | | | | | INR/ICPEES | | | | | AMU | | | |

***1st stay*: INR (13 months)**

The ESR will be trained in analytical chemistry and he will have the opportunity to be the heart of a rapidly developing innovative start-up. This company is a spin-off of ICPEES laboratory and exploits the results of the work performed by its group of atmospheric chemistry. More specifically, the ESR will contribute to the development of a microfluidic analytical device devoted to BTEX measurements in air at sub ppb levels. Based on numerical modelling already conducted in UTH, his work will aim at testing both adsorption and desorption efficiencies depending on the experimental conditions, i.e. gaseous BTEX concentrations, BTEX flow rate, residential time in the preconcentrator for adsorption or temperature and temperature increasing for desorption.

***2nd stay:* INR/ICPEES (5 months)**

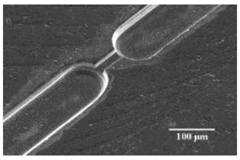
The ESR will be trained in analytical chemistry and particularly to all the techniques available in ICPEES to measure benzene and its derivatives in air at sub ppb levels. The latest version of the instrument will be evaluated in terms of limits of detection and quantitation, repeatability and reproducibility by using controlled gaseous BTEX concentrations in the range 0-50 µg $m^{-3}$.

***3rd stay:* AMU (4 months)**

The ESR will be trained in modeling using Fluent. Modeling will better characterize the flow through different configurations of preconcentrator microfluidic chips. He will contribute in making all necessary modifications and adjustments in the in-house codes to meet the specific geometry and flow conditions and to perform suitable simulations obtaining reliable results to be used in the experimental part of the work. This work will be done in collaboration with the University of Thessaly (UTH) where a preliminary work was performed.

**Requirements**

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



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

**Financial information / Salary**

Monthly gross salary at INR: 3 452 €;

Monthly mobility allowance: 600 € (researcher without family obligation) – 1 100 € (researcher with family obligation)

**Contacts:**

For further information please contact Dr. Stéphane Le Calvé (INR & ICPEES), slecalve@unistra.fr (INR & ICPEES) or Prof. Irina Martin (AMU), irina.martin@univ-amu.fr

**Application procedure:**

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

Dr Stéphane Le Calvé (INR & ICPEES): slecalve@unistra.fr

Prof. Irina Martin (AMU): irina.martin@univ-amu.fr

**Deadline: 30-11-2017**

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