



EuNetAir Newsletter

COST Action TD1105 Iss. 4/June 2014

Editorial

M. Penza

This fourth issue of Newsletter covers the Action grant period January-June 2014 to disseminate the networking activities and current research results in environmental science and technology from COST Action TD1105 (www.cost.eunetair.it) European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir, edited half-yearly in the past and in the next two years (2012-2016) by an Editorial Board, chaired by Prof. Ralf Moos (University of Bayreuth, DE) with great support by Editorial Board Manager Daniela Schönauer-Kamin (University of Bayreuth, DE). The excellent teams of over 180 involved international experts such as scientists, researchers, technologists, modelers, SMEs managers from 28 COST Countries, four International Partner Countries (IPCs) and three Near Neighbor Countries (NNC) are working hard to contribute to the objectives and workplan of COST Action TD1105 in the air quality monitoring including environmental technologies, nanomaterials, gas sensors, smart systems, air-pollution modelling, measurements, methods, standards and protocols.

(EEA), 3-4 October 2013, Copenhagen, Denmark). In these two meetings, over 80 participants from at least 25 COST countries were involved with a large participation and target audience. In this Newsletter, we will give an update on the outcome of these EuNetAir events. A special issue as EEA meeting proceedings to be published in Urban Climate (Elsevier) is expected on fall 2014.



I would like to mention and acknowledge greatly the COST office director (Dr. Monica Dietl) for her letter of support received and read to the participants of the EEA meeting in Copenhagen. Many thanks for sharing the prestigious inputs on networking and "common brains" community to generate new knowledge for science, technology and innovation.

The COST Action TD1105 held the Second Scientific Meeting including Working Groups Meeting and 4th Management Committee Meeting at Queens' College, University of Cambridge, Cambridge (UK), 18 - 20 December 2013, under local organizing chair Prof. Rod Jones. This Meeting with 60+ participants discussed on research and innovation needs in each Working Group and Special Interest Group of EuNetAir.



The Second Training School of EuNetAir on Optimized Operation of Solid-State Gas Sensors, especially for Low Concentrations was held at Saarland University, Laboratory for Measurement Technology, Saarbrücken (Germany), 31 March - 2 April 2014, with 30+ trainees and eight trainers from at least 20 COST countries and the USA. Also, EuNetAir supported the participation of five trainees to the ISOCS Short Course Winter 2014 on Fundamentals and Applications of Chemical Sensors, Les-Houches Chamonix (France), 9-14 February 2014.

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The concerted COST Action TD1105 is very pleased to present the networking/dissemination results of the national/international research from Action partnership to various international conferences/workshops such as Second International Workshop on New Sensing Technologies for Indoor and Outdoor Air Quality Control (25-26 March 2014, Brindisi, Italy) with special focus on clean air for smart cities; and WG1-WG4 Meeting on New Sensing Technologies and Methods for Air-Pollution Monitoring (European Environment Agency



Editorial

Furthermore, EuNetAir supported 15 Short Term Scientific Missions (STSMs) in the year 2 (1 July 2013 - 30 June 2014) for visit and exchange of motivated early stage researchers and experienced scientists from a laboratory to another one in order to start and consolidate new international research collaborations in the whole area of EuNetAir topics for fruitful networking in S&T cooperation.

A Symposium on Advanced Functional Materials for Environmental Monitoring and Applications was organized at European Materials Research Society (EMRS), Spring Meeting 2014, 26-30 May 2014, Lille (France). This Meeting was well-attended with high-quality lectures in the specific science and technology. The number of submitted abstracts was more than 200 and it was ranked as top 7 over 30 symposia of the EMRS-2014 conference. A special issue will be published in the open access journal "Journal of Sensors and Sensor Systems (JSSS)", Copernicus Publications. All contributions will be strictly peer-reviewed and have to extend the proceedings. Its publication is



expected in December 2014. The 5th MCM of EuNetAir was held on 30 May 2014 in Lille after the symposium with an excellent participation of two invited speakers, Prof. Giorgio Sberveglieri (University of Brescia, Italy, as MC Member and chairman of the 2014 Eurosensors conference) and Prof. Jacques Amouroux (Université Pierre et Marie Curie, Paris, France), as the delegate of the EMRS board.

Finally, EuNetAir, represented by Action chair, participated to the COST Annual Progress Meeting in Dubrovnik (Croatia), 12-13 May 2014, to report on progress of the Action TD1105 activities to the ESSEM Committee related to the second grant period (1 July 2013 - 30 June 2014). The feedback from other Action chairs, DC members and DC rapporteurs was highly positive and encouraging.

On behalf of the Action management committee, I would like to thank ALL Action participants for their valuable scientific work, their kind availability and their great enthusiasm that will make our Action very successful as an excellent S&T platform to address in collaborative research teams the upcoming Horizon 2020!

Focus On

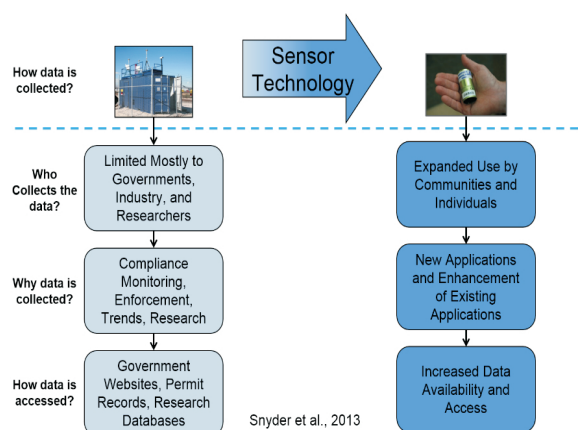
Focus On

"Change the Paradigm"

T. Watkins

The convergence of low cost air pollution sensors, low cost wireless data communication devices, new platforms for accessing data, and the smartphone/tablet generation has the potential to "Change the Paradigm" for how we monitor air pollution. We monitor air pollution for a variety of reasons at a variety of scales, ranging from personal measurements of exposure for research studies to ambient air measurements to track trends and measure compliance with air pollution standards. Previously, we typically monitored air pollution using large, highly costly, complex instrumentation which limited who collected data, why data was collected, and where data was stored and accessed. However, the emergence of low cost easy-to-use sensors has the potential to change who, why, and how we collect and access air pollution data (see figure: *The Role of Sensors in Changing the Paradigm of Air Pollution Monitoring*). However, there are also significant challenges with the application of these new devices including interpretation of the data from quality and public health perspective. From a data quality perspective, we need to understand the performance and reliability of the sensors, as well as, how the sensors are deployed in field. From a public health perspective, we need to understand and communicate how short-term measurements taken by sensors relate to public health based standards that are based upon longer exposure times (e.g., average annual or daily exposures).

The United States Environmental Protection Agency (US EPA) is working with sensor developers and users to help facilitate the responsible and effective use of low cost air pollution sensors.



Activities at the US EPA include evaluating sensors in both laboratory and field settings, supporting communities with the application of sensors including interpretation of data, and developing guidance documents and materials. Through these efforts, the US EPA hopes to take full advantage of the tremendous promise that sensor technologies offer to help air quality management organizations protect public health.

Ref: Snyder et al, 2013. The Changing Paradigm of Air Pollution Monitoring. Environ. Sci. Technol. 2013, 47 (20), 11369-11377.

Focus On

What brings the future for emerging sensor technologies?

J. Suisse, M. Bouvet

Currently, the most used sensing materials are inorganic oxides, which have been studied for over 50 years and which are still commercialized by many companies. Their main advantages and drawbacks are well known.

Is there still room for new and emerging technologies in this context? Which features should new sensors have?

Some of the current needs of the industry are for low energy consumption sensors for emerging markets (e.g. sensors for mobile phones), for low energetic processes (solvent processing, ink-jet printing, etc.). There is also a need for flexible

sensors. Their fabrication processes are compatible with existing products and technologies, to be integrated, for instance, in smart textiles and organic electronic based systems. No matter of the developed technology, the sensing material must be fully characterized. In addition, each system will need to be designed and developed for a specific application, to improve accuracy by taking into account the operating environment of the sensor (for instance in the presence of interfering species). This is especially important for air quality monitoring applications. The requirements for indoor sensors are an example in this area. They are different from those of outdoor applications.

By bringing together scientists of various fields and countries, the EuNetAir COST Action is actively participating in the emergence of these future technologies.

COST Actions: A Great Opportunity as Incubators for Molecular Science and Technology

M. Alvisi

SIG1 "Network of Spin-offs" invited as a best practice to the CMST COST Conference in Bruxelles

Our COST Action SIG1 "Network of Spin-offs" and Companies have been invited to the Cost Event: "A Great Opportunity as Incubators for Molecular Science and Technology" hold on March 27th-28th 2014 in Brussels. The SIG1 leader M. Alvisi illustrated the motivation, composition, scope and activity of this Network in the frame of EuNetAir Action.

The event provided background information on legal issues, managing skills, business-oriented networking, venture capital, policy mechanisms and it stimulated technology transfer from COST Actions. During the event, successful examples of spin-off created or working within CMST Actions have been showcased.



In fact, COST (the European Cooperation in Science and Technology) is an ideal platform for addressing these challenges because it is based on networking at the interface of science and technology. The special profile of CMST (Chemistry and Molecular Sciences and Technologies, one of the domains of our trans-domains Action) at the interface of biology, pharmacy, medicine, and materials pushes this COST Domain to take on the challenge and organize a public event thanks to its location at the frontier of modern technology and innovation. In summary, an event of this type included scientists with entrepreneurship ideas, stakeholders and policy makers will fit ideally within Horizon 2020.

The Conference has been registered and all documents related to (report, photo, video (<http://www.cost.eu/media/multimedia/COST-Actions-A-Great-Opportunity-as-Incubators-for-Molecular-Science-and-Technology2>), slides) could be visible at this link: <http://www.cost.eu/events/actionsincubators>

Conference report: International Meeting of Chemical Sensors 2014

R. Moos

The International Meeting on Chemical Sensors (IMCS), the world's largest interdisciplinary forum for all aspects of Chemical Sensors, was held in Buenos Aires, from March 16th to 19th, 2014 organized by Prof. Alberto Lamagna, Research and Development Area, National Atomic Commission of Argentina.

In the precedent conference in Nuremberg, Germany, two special EuNetAir sessions were arranged as a very successful inclusion into the conference. Some of the EuNetAir academic participants are also IMCS steering committee members. In 2014, almost 40% of the IMCS participants came from Europe to join the conference, despite the required long-haul flights to Buenos Aires.

With four invited plenary talks and 24 invited focused session talks, IMCS 2014 covered all

aspects of chemical sensors and chemical sensing. One of the European highlights came from Prof. Maximilian Fleischer of Siemens, who discussed aspects of science and commercialization in his plenary talk "Innovation trends through the "sixth sense" chemical sensing."



IMCS is an interdisciplinary forum in the field of Chemical Sensors that includes physics, chemistry, materials science, and engineering disciplines (including biomedical engineering). Similar to the EuNetAir Action, it is the intention of IMCS to boost research

and application in the field of Chemical Sensors and to bring advanced science in close contact to market needs. It is considered as an international platform for discussion and exchange between experienced researchers and younger students. The next IMCS will be held in Jeju, Korea from July 10 to July 13, 2016. Contributions from EuNetAir participants are planned.

News from Working Groups

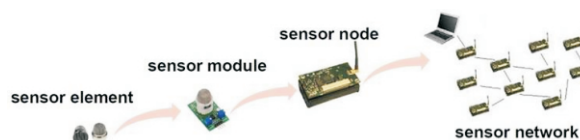
Working Group 2 - A. Schütze
Sensors, Devices and Systems for AQC

The Working Group 2 (WG2) meeting in Cambridge, UK, December 18-19, 2013, again highlighted the broad spectrum of technologies for sensors, devices and sensor systems for Air Quality Control, for example with plenary presentations on The US EPA Roadmap for Next Generation Air Monitoring (Tim Watkins, Deputy Director for US EPA's Air, Climate and Energy Program, EPA) and OpenSense: City-Scale Air Quality Monitoring with Wireless Sensor Nodes (David Hasenfratz, ETH Zurich) as well as several presentations in the WG2 special session, for example SiC based Field Effect Sensors for Emissions Monitoring and Air Quality Control (Mike Andersson, Linköping University), Photo-acoustic Spectroscopy Utilizing AFM-based Cantilever Detection Technique (Zdenek Zelinger, Academy of Sciences of the Czech Republic) and From Silicon to Plastic Technologies for Environmental Monitoring Microsystems (Giorgio Mattana, EPFL, IMT-SAMLAB). The latter presentation was accompanied by a poster on Inkjet-Printed Organic Field Effect Transistors Functionalised with Odorant Binding Proteins for the Detection of Volatile Organic Compounds from the same group highlighting the potential for integration of biomolecular receptor into low cost sensor systems. The presentation by Julian Gardner, University of Warwick, on Dual High-Frequency

Surface Acoustic Resonator for Fine Particles addressed an issue still somewhat neglected by the low-cost sensor community, but requiring greater attention due to its high relevance for air quality, both in- and outdoors. All abstracts and presentation slides can be found on the EuNetAir website.

In the following discussion, the WG2 members reviewed the research and innovation priorities discussed in the Rome meeting (Dec 2012). Some aspects were found to require increasing attention, extending the existing list of R&I needs:

- (nano)particle detection for dust and aerosols
- self-referencing of sensors at the sensor module level
- complex, but easy to use systems



Participants concluded that the immense scope of WG2 (from nanomaterials to sensor networks) requires the identification of reference applications, in which the potential of micro/nano-sensor systems for environmental monitoring is demonstrated including an assessment of the performance. One possible step in this direction might be sensors on/in smartphones with an open data interface allowing app developers to design their own applications and make best use of the sensor element by optimizing the operating mode and data evaluation.

News from Special Interest Groups

Special Interest Group 1 - M. Alvisi
Network of spin-offs

During the meeting in Cambridge in December 2013, the SIG1 worked on innovation needs and priorities from the point of view of companies and spin-offs. The group was composed of Italian and French spin-offs, an English medium sized company, an English spin-off, and a Swedish medium sized company. The discussion was very helpful. The two main challenges were: to contribute to innovation and priority outcomes from the point of view of spin-offs and companies but not in terms of research activities and to converge and synthesize on a few key issues. The results of this work are outlined in the table.

In order to pursue the objective of the SIG, the following activities have been proposed:

- News for SMEs and spin-offs on research opportunities
- Periodical survey on recent relevant patents on AQC topics
- Lobbying in AQC on specific topics
- Promotion of instruments for opportunities for partnership search
- Connection with local and regional TT networks to intercept opportunities
- Communication of business opportunities
- LinkedIn group of SIG1 (with no email alert!!)
- Partnership and common links with EEN organization.

INNOVATION REQUIREMENTS	GENERAL NEEDS
<ul style="list-style-type: none"> • Evaluate market opportunities for encouraging EU investment in specific topic of AQC and direct SME, RD effort. • Develop legislation in different areas of air quality control • Push the creation, extension and adoption of regulations (i.e. methodologies, guidelines) at EU levels • Low cost and easy-to-use devices for odor monitoring • Training school for new "ambassadors" that can promote air quality management • Engage the citizens of the AQC concept • Education and dissemination of AQC concept (schools, institutions, sales, politicians, NGO etc.) 	<ul style="list-style-type: none"> • Cooperation (promote the instruments of partner search and interaction in this action) • Education (virtual training schools) • Infrastructures (network of SME in ACQ to produce an surplus values, PRO ECO2, shared calibration, testing and characterization facilities) • Finance (promote the EU instruments in Horizon 2020) • Legislations (already listed) • Coaching (already existing) • Business models

News from Ad-Hoc Groups

Short Term Scientific Missions (STSMs)

J. Theunis

A second Call for Short Term Scientific Missions (STSMs) was launched in June 2013 to give opportunity to young researchers, PhD-students and graduated early-scientists to apply for scientific missions in host laboratories of Action partners in MoU-signed COST. In the second year of the Action a total of 14 STSMs were granted and have been carried out meanwhile (see also in Newsletter 3). This newsletter contains short reports of them.

- Jordi Sama, PhD-student - Single Nanowire contacted by Electron Beam Lithography
- Jose Luis Ramirez, Professor of Electronics - Implementation of nanostructured MOx gas sensors on plastic foil substrates and their integration in a system with wireless communication capabilities
- João Ginja, Technical Engineer - Evaluation of micro-sensors against standard methods for Air Quality Control during field campaigns

- Jean-Moïse Suisse, Assistant Professor - MSDI-based Gas Sensors for reliable Ammonia sensing in moist environments
- Iglia Etopolska, PhD student - MyAir tool training
- Pierre Gaudillat, PhD student - Impedance measurement on conductometric sensors based on new organic heterojunctions (MSDs)
- Sadullah Ozturk, PhD student - Functionalization of ZnO nanorods with metals and metal oxides for gas sensing applications

A new call for STSM proposals for year 3 of the Action has been opened. For details see the EuNetAir website. In the third Action year an estimated number of 15 STSM will be funded. (http://www.eunetair.it/cost/documenti/COST_Action-TD1105_Call-STSM_Year3_V4.pdf). Deadlines for applications are Sep. 1, 2014, Dec. 1, 2014, and March 1, 2015. Applicants are requested not to wait until the final deadline to submit their application.

Gender Balance

I. Steinberga

In the second scientific meeting of Working Groups and Management Committee held in December 2013 at University of Cambridge, Queens' College Cambridge, UK, between approximately 2/3 to 3/4 of all oral talks and posters presentations (including session chairs) were given by male persons. It has

been observed that only SIG4 (Expert comments for the revision of the Air Quality Directive (AQD)) was run under equivalent gender balance.

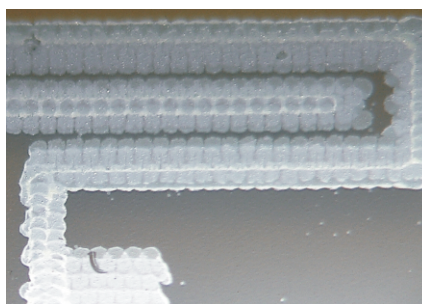
Science & Tech Talk: STSM reports

Science & Tech Talk

Implementation of nanostructured MOx gas sensors on plastic foil substrate and its integration in a system with wireless communication capabilities

J. L. Ramirez

I am a researcher at the Microsystems Nanotechnologies for Chemical Analysis (MinoS) group in Universitat Rovira I Virgili (Tarragona, Catalonia, Spain). Its main research line is devoted to design, fabrication and characterization of chemical microsystems, especially gas sensors arrays. This Short Term Scientific Mission (STSM), in the framework of COST Action TD1105, has allowed me to spend one month in EnviroMEMS group, at Ecole Polytechnique Federale de Lausanne, IMT-SAMLAB (Neuchatel, Switzerland). Their main goal is to develop environmentally-conscious microfabrication processes and



microsystems. They have very strong competence at electronics inkjet-printing over polymeric substrates. So, a very promising collaboration is envisioned in joining efforts to design a gas sensing system based on nanostructured metal oxide layers over plastic foil substrates, integrated in a programmable wireless architecture. The stay has been very fruitful and became a solid basis for long term collaboration. At personal level, this has been a great and pleasant experience.

Science & Tech Talk: STSM reports

Single Nanowire contacted by Electron Beam Lithography

J. Sama

I am a PhD student at University of Barcelona. My research topic is focused on semiconductor nanowires acting as a low power gas sensor for monitoring toxic gas species. The Cost Action EuNetAir offered me by means of a STSM grant the opportunity to spend one month in the amazing town of Braunschweig, Germany, to deepen and learn into the Electron Beam Lithography technique.

The Institute has long experience in the field of wide bandgap semiconductors and using nanostructures as building-block in several fields (optics, spintronics, etc.). The short stay was a useful experience in order to develop a technique that will extend our knowledge of contacting nanostructures, in the mentioned topic. Also, the stay has opened some collaboration in topics that are in common between both institutions.

Evaluation of micro-sensors against standard methods for Air Quality Control during field campaigns

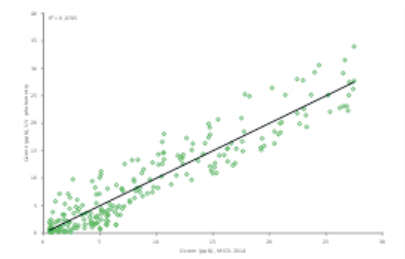
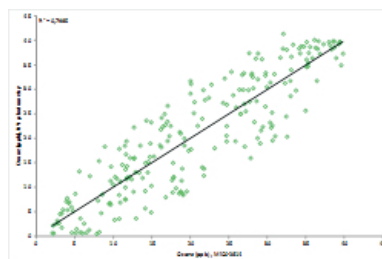
J. Ginja

This one week duration STSM had the primary goal to assess and analyze results from the comparison exercise between SGX Sensortech sensors and IDAD's analyzers using EU standard Air Quality Methods.

The STSM allowed a preliminary treatment of information and definition of guidelines to develop the analysis. The correlation between measurements, especially for O₃, confirms that micro-sensors could be a promising technique for Air Quality Monitoring. Their performances allow new strategies for Air Quality Control, rapid mapping of air pollution over small areas, validation of dispersion models or evaluation of population exposure.

This visit offered the possibility to consolidate the cooperation between SGX Sensortech and IDAD regarding micro-sensor evaluation and improvement of sensor performance and characteristics. Finally, the STSM provided me with additional insights into the state-of-the-art of micro-sensors including aspects of technology and operation. From a personal point of view, it was a really helpful and joyful experience, for the knowledge exchange and the very friendly welcome by SGX team.

The figures show examples of the correlation between micro-sensor and UV analyzer.



Impedance measurement on conductometric sensors based on new organic heterojunctions (MSDIs)

P. Gaudillat

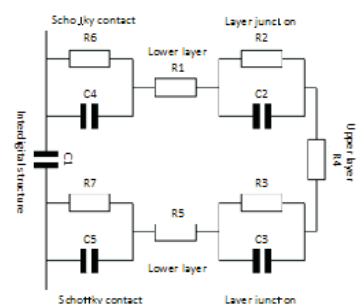
The present Short Term Scientific Mission is a joint research project between the Molecular Chemical Institute of the University of Burgundy, Dijon, France and the Department of Mechatronics and Measurement Technology of the Saarland University, Saarbrücken, Germany. The aim was to characterize the new transducers, called MSDIs (Molecular Semiconductor-Doped Insulator heterojunction), which have been recently patented by Prof. Marcel Bouvet, by impedimetric measurement (Prof. Andreas Schütze's team), which can give us new information on the effects of the interface between the two materials used in the sensor. A mid-term goal is also to prepare a bimodal sensor using conductometric and impedimetric transducers.

The impedimetric measurement yielded very interesting results to understand what happens at the interface between the two layers, knowing that

this interface is the most important parameter of this device.

Moreover, impedance measurement and fitting enables the quantification of humidity, as well as the separation of the effects from NH₃ and humidity, allowing multimodal detection.

The figure shows an equivalent circuit of the MSDI device known by impedimetric measurement.



[1] M. Bouvet, V. Parra, Semiconductor transducer and its use in a sensor for detecting electron-donor or electron-acceptor species, Brevet US US8450725B2.

[2] V. Parra, J. Brunet, A. Pauly, M. Bouvet, Molecular semiconductor-doped insulator (MSDI) heterojunctions: an alternative transducer for gas chemosensing, *Analyst*, 134 (2009) 1776–1778.

Science & Tech Talk: STSM reports

MyAir tool training

I. Etropolska

CERC (Cambridge Environmental Research Consultants) is the team that created and developed the MyAir tool kit under the European project "Pasodoble". It compares and evaluates modeled and observational data of atmospheric pollutants, producing graphics as well as text based statistics for inclusion in scientific papers and reports. My one-week-visit at CERC office was an exceptionally useful experience in terms of working and modifying the tool kit in order to better suit the need of our Working Group to gain

statistical evaluation of our pollution modeling system output. Modifications were made to allow observation data in XML format to be read by the tool and additional adjustment of the output images to allow importation in web pages and presentations. A limited functionality web interface was developed to be used when extracting observation data on the fly from a database. Finally, I would like to thank my hosts for the warm welcome and for providing an excellent environment for learning and for fast and effective experience exchange. I am also grateful to COST Action TD1105 for the opportunity to work with those people and to see Cambridge, UK.

Functionalization of ZnO nanorods with metals and metal oxides for gas sensing applications

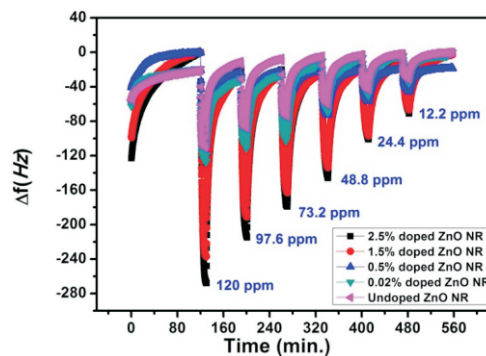
S. Ozturk

During my STSM in Brindisi, I was welcomed by Michele Penza and his team. I was involved from one side to some experimental activities and to the other side to some events which were organized by the host institution for my stay. In this STSM, doped and undoped ZnO nanorods were fabricated on gold electrodes of QCM transducers by using a solution-based deposition technique. The fabrication and structural characterization of doped and undoped ZnO nanorods were carried out in

Turkey. On the other hand, synthesized samples were tested to different types of environmentally air pollutant in ENEA, ITALY (volatile organic compounds (VOCs) and hazardous gases).

The figure shows the ethanol responses of doped and undoped ZnO nanorods versus time.

We plan to write some publications of this research project. Additionally, some parts of our results will be presented in some international conference as a poster and oral presentation which be held on in the 2014.

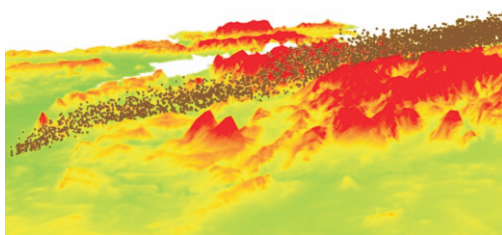


Overview on EuNetAir Events

Summary of the poster session of the 2nd scientific meeting in Cambridge as seen by an ESR

C. Skjøth

The poster sessions were carried in relation to the coffee breaks and was sufficiently large to be interesting (about 5-10 posters) and sufficiently small for us to have to discuss with interested participants. The poster session in general had two topics: 1) Development of new sensors, 2) Development and application of air quality models.



Besides that then an interesting poster on of GPS enabled mobile sensors + smartphone technology demonstrated high resolution mapping of air pollution in Italy. The sensor development focus on basic development VOC sensors using biomolecules, the use of nano-structures for detecting H₂S or practical development of a device for measuring human exhaled breath under "field" conditions. The atmospheric modelling included traditional model tools such as chemistry transport modelling for forecasts or trajectory studies for receptors studies and process understanding. Interestingly enough both modelling studies had an anthropogenic component on emissions as well as a component on natural emissions (dust and fungal spores). The figure shows an example on receptor modelling of natural emissions (spores) in England using the weather forecast model WRF and the particle dispersion model HYSPLIT.

The poster sessions were very well attended – in fact it was very busy from time to time – and provided a good chance for ESR to both present their material and discuss with more experienced scientists.

Overview on EuNetAir Events

Summary of 2nd Training School in Saarbrücken

A. Schütze

The 2nd EuNetAir training school, organized in Saarbrücken, Germany, from March 31 to April 2, 2014 focused on the optimized operation of solid state gas sensors for environmental technologies and Air Quality Monitoring. The first day concentrated on basic know how on sensor technologies, namely metal oxide semiconductor (MOS) gas sensors and gas-sensitive field effect devices (GasFET), and test equipment describing two very different approaches developed at JRC Ispra (allowing rigorous sensor assessment) and at Saarland University (providing wide dynamic range from sub-ppb up to % level, especially for VOCs).



After a brief introduction of the state-of-the-art of dynamically operated sensors, the second day addressed different methods of dynamic operation modes to improve sensitivity, selectivity and stability, namely temperature cycling, impedance spectroscopy, surface ionization and optical excitation for MOS sensors plus temperature cycling and gate bias cycling for GasFETs. Combinations of these approaches were also discussed, e.g. for sensor self-monitoring (combined TCO/EIS for MOS sensors), as well as requirements for the electronics to drive the sensors and for comprehensive data evaluation. The third day then focused on data evaluation with

a theoretical introduction plus practical experience in the computer pool at Saarland University with tools developed in the Lab for Measurement Technology (LMT). In addition, a short exhibition allowed participants to view and discuss state-of-the-art microsensors and sensor systems as well as R&D tools for sensor system development.



The program was rounded off with poster presentations by all trainees during coffee and lunch breaks allowing an intensive exchange between trainees and trainers as well as among participants, a lab visit to the LMT gas testing lab and, last but not least, a social dinner organized by EuNetAir for all participants. The intensive discussions after the different presentations as well as during the breaks and the dinner showed the great interest of all participants in combining advanced nanomaterials, which many of the trainees target in their research, with optimized operating modes for achieving improved performance.



In addition, the training school showed clearly that this interdisciplinary field requires collaboration between groups from chemistry and physics, materials and sensor devices as well as systems integration and data evaluation.

Further information: <http://www.LMT.uni-saarland.de/EuNetAir>

2nd Training School in Saarbrücken - View of a trainee

I. Marr

When we arrived in Saarbrücken, we already had the schedule of this training school but no idea what to expect. Many of us PhD students investigate high performance materials for gas sensing applications but how does it work in "real life"? This 2nd training school gave us a broad overview what can be done with the materials, we optimize in our labs, when they are applied into a sensing device. We got much information from testing conditions, material properties and measurement technology over operation modes and data processing (also by hands-on training) to the validation of gas sensors



and their application in urban or industrial environment. Especially the meeting with representatives from different companies during the demonstration of their gas sensors and operating platforms was an excellent opportunity to learn on the one hand about the state-of-the-art and on the other hand about the challenges that have to be met in the field of gas sensor research.

Thanks to Prof. Andreas Schütze and his group as well as Juliane Roßbach. They did a great job with the organization. The training school was a very successful and fruitful meeting, with a lot of scientific exchange between us trainees, but above

all, we will benefit from the knowledge of the experienced trainers.

Overview on EuNetAir Events

Summary of 2nd International Workshop in Brindisi

M. Alvisi, M. Penza

In the 2nd workshop Action partners were involved together with European speakers from Action, external international experts, young researchers, scientists, practitioners, and stakeholders.

The Workshop was well-attended from 45 researchers. After the welcome address from the Major of Brindisi, the Apulian Region delegate and the Head of ENEA-Brindisi, the plenary session has been animated by Prof. Krishna Persaud (Univ. of Manchester). He presented his recent results on artificial olfaction systems for Air-Quality Monitoring applications, followed by Nuria Castell-Balaguer (Norwegian Institute for Air Research) who introduced the topic of Smart City and the role of



low-cost sensors in monitoring urban environments.

Up to 15 oral contributions were given during the first day in the scope of the session topics: "Clean Air for Smart Cities", "Sensing Technologies for Indoor Applications", and "Method and Applications for Environmental Sustainability".

The second day of the workshop followed an intensive program including two oral sessions dealing with advanced materials for chemical sensors, sensors and systems for Air Quality Control and a poster session dedicated to materials, sensors, and systems for Air Quality Monitoring. Up to ten oral presentations and four posters have been presented together with the conclusions and the presentation of the future activities of the EuNetAir Cost Action.

In overall, the COST meeting has been a good success due to the high scientific level of the contributions as well as due to the involvement of local stakeholders and institutions on the Action topics.

Summary of ISOCS Short Course Winter 2014

C. Pijolat

The network ISOCS (International Society for Olfaction and Chemical Sensing) has organized its Winter School 2014 in February 2014 (9 to 14) at Ecole de Physique Les Houches located in the Valley of Chamonix (France). This school was also supported by the cost action TD1105 EuNetAir and the French scientific club CMC2 (Club Micro Capteurs Chimiques). The school was co-organized by C. Pijolat from CMC2 and J. Mitrovics for ISOCS. The overall theme was "Reactivity of solids, Kinetics, Catalysis, Definitions and Applications of Chemical Sensors".

This short course covered various topics including: Adsorption and kinetics of transformation in solids (Prof. Michèle Pijolat, EMSE St-Etienne), Catalysis for gas-solid interactions (Dr. P. Vernoux, Institute of Catalysis Lyon), Point defects in solids (Dr. J.P. Viricelle, EMSE St-Etienne), Biosensors (Prof. K. Persaud SCEAS University of Manchester), Electronic noses and their application (Prof. J.

Gardner, University of Warwick), Definition of sensors (Prof. C. Di Natale, University Tor Vergata, Roma), Nano-sensor preparation (Prof. E. Comini, University of Brescia), Automotive gas sensors (Prof. C. Pijolat, EMSE St-Etienne), Food application of electronic nose (Dr. V. Sberveglieri, University Modena e Reggio Emilia) and practical demonstrations (Dr. J. Mitrovics, JLM Innovation, Tübingen, Germany). A presentation of the COST Action EuNetAir has been made. Amongst the 15 students (from eight nationalities) who attended this school, five of them were granted by the Cost Action EuNetAir.



Overview on EuNetAir Events

Summary of EUROPEAN MATERIALS RESEARCH SOCIETY (EMRS) Spring Meeting 2014

Symposium B - Advanced Functional Materials for Environmental Monitoring and Applications

M. Penza, A. Romano-Rodríguez and A. Lloyd Spetz

A Symposium on Advanced Functional Materials for Environmental Monitoring and Applications was organized at European Materials Research Society (EMRS), Spring Meeting 2014, 26-30 May 2014, Lille (France). The Symposium Organizers were: Michele Penza, ENEA, Brindisi, Italy; Anita Lloyd Spetz, Linköping University (Sweden) and University of Oulu (Finland); Albert Romano-Rodríguez, University of Barcelona, Barcelona, Spain; Yongxiang Li, Chinese Academy of Sciences, Shanghai, China; Meyya Meyyappan, NASA Ames Research Center, Moffett Field, CA, USA.



This meeting was greatly attended with high-quality lectures in science and application technology. The number of submitted abstracts was more than 200 and the symposium was ranked as top7 of over 30 symposia of the EMRS-2014 Conference. The rejection rate (or move to other symposia) amounted to 11%. 17 invited speakers and 55 speakers contributed to specific lectures distributed in 13 oral sessions. 107 poster presentations were organized in two poster sessions. The participants were coming from Europe (75%), Asia/Oceania (18%) and America (7%).



The main topics covered by the Symposium B were:

- Advanced gas sensing semiconducting materials
- Hybrid materials and nanocomposites for gas sensing
- Catalytic sensing materials
- Device fabrication, packaging, testing and aging
- New (nano)sensors for monitoring gaseous and liquid pollutants
- Ab initio modeling of gas/surface interaction
- Surface-sensitive spectroscopies for studying sensor/gas interaction
- Modeling of materials, devices and sensor systems
- Functional applications

The Sessions devoted to nanostructured metal oxides chemical sensors, graphene chemical sensors, integration of nanosensors for scale-up, carbon nanomaterials for gas detection, modeling of sensors and sensor/gas interaction, hybrid and composite materials for bio- and chemical sensing, nanomaterials and nanotechnologies for environmental chemical sensing, optical gas sensing, catalytic chemical sensing materials, sensors for VOC detection, and finally new nanosensors and sensor concepts were very well-attended and many fruitful discussions started after each presentation.



A special issue will be published in the open access journal "Journal of Sensors and Sensor Systems (JSSS)", Copernicus Publications. All contributions will be strictly peer-reviewed and have to extend the proceedings. Its publication is expected in December 2014.

Graduate Student Awards Competition was managed with a Committee of 6 Members to select two awards among five candidates or applicants. The two winners received 450 Euro and a diploma. They are Manuel Bastuck (Saarland University, Saarbrücken, Germany) and Sergio Roso Casares (University Roviri I Virgili, Tarragona, Spain). The symposium waived the conference-fee (in form of a grant) for three invited speakers, eleven Early Stage Researchers (ESRs), and two symposium assistants.



Symposium B was supported by six Sponsors (Alphasense, UK; Ethera, France; SGX-Sensortech, Switzerland/UK; SenseAir, Sweden; 2M Strumenti, Italy; UST, Germany). All are companies strongly involved in sensors and sensor system manufacturing and/or in the sensor instrument business.



Finally, the 5th MCM of EuNetAir was held on 30 May 2014 in Lille after the symposium with the excellent participation of two invited speakers:

- Prof. Giorgio Sberveglieri, University of Brescia, Italy, MC Member and Chairman of the Eurosensors 2014
- Prof. Jacques Amouroux, Université Pierre et Marie Curie, Paris, France, Delegate of EMRS Direction

Announcements **Upcoming Events**

Urban Environmental Pollution 2014, Climate Change and Urban Environment

June 12-15, 2014, Toronto, Canada
<http://www.uepconference.com/>

Air Pollution 2014, 22nd International Conference on Modelling, Monitoring and Management of Air Pollution

July 7-9, 2014, Opatija, Croatia
<http://www.wessex.ac.uk/14-conferences/air-pollution-2014.html>

ICEPR'14, 4th International Conference on Environmental Pollution and Remediation

August 11-13, 2014, Prague, Czech Republic
<http://icepr.org/index.html>

IEEE NANO, 14th International Conference on Nanotechnology

August 18-21, 2014, Toronto, Canada
<http://ieeenano2014.org/index.htm>

8th International Conference on Sensing Technology (ICST 2014)

September 2-4, 2014, Liverpool John Moores University, United Kingdom
<http://www.ljmu.ac.uk/BLT/BEST/ICST2014/index.htm>

EuroSensors 2014

September 7-10, 2014, Brescia, Italy
<http://www.euroSensors2014.eu/>

Special Session EuNetAir / Core-Group Meeting to EUROSENSORS 2014

September 7-10, 2014, Brescia, Italy

WG1-WG4 Meeting on New Sensing Technologies for Air-Pollution Monitoring and Start of the Air Quality Joint-Exercise Intercomparison

October 13-15, 2014, IDAD - University of Aveiro, Aveiro, Portugal

IEEE SENSORS 2014 International Conference

November 2-5, 2014, Valencia, Spain
<http://ieee-sensors2014.org/>

ICEPP 2014, 2nd International Conference on Environment Pollution and Prevention

November 12-14, 2014, Auckland, New Zealand
Abstract submission deadline: 25 June 2014
<http://www.icepp.org/>

3rd SCIENTIFIC MEETING: WGs Meeting and 6th MC Meeting

December 3-5, 2014, GEBZE Institute of Technology, Istanbul, Turkey

3rd International Conference on Nanostructures, Nanomaterials and Nanoengineering (ICNNN 2014)

December 26-28, 2014, Hong Kong
Paper submission deadline: 25 July 2014
<http://www.icnnn.org/>

3rd International Workshop of the COST Action TD1105 on New Trends and Challenges on Air Quality Control

March 26-27, 2015, University of Latvia, Riga, Latvia

3rd International Training School on Atmospheric Aerosol Physics, Measurements and Sampling

May 2-8, 2015, Hyytiälä Station of the University of Helsinki, Helsinki, Finland

4th SCIENTIFIC MEETING: WGs Meeting and 7th MC Meeting

June 3-5, 2015, Linköping University, Linköping, Sweden

Publications of EuNetAir participants

List of publications related to EuNetAir

1. Special Issue - New Sensing Technologies and Methods for Air-Pollution Monitoring - managed as Proceedings of the Action meeting (3-4 October 2013) at the European Environment Agency (EEA) in the journal *Urban Climate* (Elsevier) with 21 submitted Manuscripts. Guest Editors: Michele Penza (ENEA, Italy), Anita Lloyd Spetz (Linköping University, Sweden), Ulrich Quass (IUTA eV, Germany), Ole Hertel (Aarhus University, Denmark). Publication expected on November-December 2014.
2. M. Penza, P. Martin, J. Yeow, *Gas Sensing Fundamentals*, Book Chapter: Carbon Nanotube Gas Sensors, edited by Springer (online edition), 2014 published. In press.
3. Z. Darmastuti, C. Bur, P. Möller, R. Rahlin, N. Lindqvist, M. Andersson, A. Schütze, and A. Lloyd Spetz, SiC-FET based SO₂ sensor for power plant emission applications, *Sensors and Actuators B: Chemical*, 194 (2014) 511-520. DOI: 10.1016/j.snb.2013.11.089.
4. C. Bur, M. Bastuck, A. Lloyd Spetz, M. Andersson and A. Schütze, Selectivity Enhancement of SiC-FET Gas Sensors by Combining Temperature and Gate Bias Cycled Operation Using Multivariate Statistics, *Sensors and Actuators B: Chemical*, 193 (2014) 931-940, DOI: 10.1016/j.snb.2013.12.030.
5. M. Bastuck, C. Bur, A. Lloyd Spetz, M. Andersson, and A. Schütze, Gas identification based on bias induced hysteresis of a gas-sensitive SiC field effect transistor, *J. Sens. Sens. Syst.*, JSSS, 3, (2014), 9-19. DOI: 10.5194/jsss-3-1-2014.
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10. A. Vásquez Quintero, B. van Remoortere, E.C.P. Smits, J. van den Brand, D. Briand, H.F. M. Schoo, N. F. de Rooij, Foil-to-foil lamination and electrical interconnection of printed components on flexible substrates, Accepted for publication in *Microelectronic Engineering*, 2013.
11. J. Courbat, L. Yue, S. Raible, D. Briand, N.F. de Rooij, Drop-coated metal-oxide gas sensor on polyimide foil with reduced power consumption for wireless applications, *Sensors and Actuators B: Chemical*, 161 (2012) 862-868.
12. J. Rossignol, G. Barochi, B. de Fonseca, J. Brunet, M. Bouvet, A. Pauly, L. Markey, Microwave-based gas sensor with phthalocyanine film at room temperature, *Sensors and Actuators B: Chemical*, 189 (2013) 213-216, DOI: 10.1016/j.snb.2013.03.092.
13. J. Hue, M. Dupoy, T. Bordy, R. Rousier, S. Vignoud, T.-H Tran-Thi, C. Rivron, L. Mughherli, Y. Bigay, P. Karpe, Benzene detection by absorbance in the range of 20 ppb-100 ppb. Application: Quality of indoor air, M. Charbonnier, *Sensors and Actuators B: Chemical*, (2013), DOI: 10.1016/j.snb.2013.03.047.
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EuNetAir



EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



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