

Opening Editorial

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It is a great honor and my pleasure to welcome this first issue of the **Newsletter** as a regular dissemination and outreach product from COST Action TD1105 European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir, edited half-yearly in the next four years (2012-2016) by an Editorial Board, chaired by Prof. Ralf Moos (University of Bayreuth, DE) with Editorial Board Manager by Daniela Schönauer-Kamin (University of Bayreuth, DE).

The aim of the **Newsletter** is to provide briefly science and technology news and to advice on related events towards involved Action participants and new affiliated members in order to disseminate Action results towards other sensor and technology communities, interested scientists and technologists, international stakeholders, and regional/national policy-makers.

A lot of credit goes to the excellent team of researchers who have been worked hard to support and contribute to the general objectives and working plan of COST Action TD1105 in the air quality monitoring field including environmental technologies, nanomaterials, gas sensors, smart systems, air-pollution modeling, measurements, methods, standards, and protocols.

We strongly expect that Working Groups (WGs) leaders, Special Interest Groups (SIGs) leaders, Ad-Hoc Committees coordinators, Action participants and Early Stage Researchers (ESRs) will contribute to the further issues of the **Newsletter** with short notes and inputs in the several sections of the **Newsletter** in order to circulate proper information to strengthen R&D networking for collaborative research teams.

The concerted COST Action TD1105 is very pleased to present the Action dissemination results of the national/international research from Action partnership to various international conferences/workshops such as IMCS-2012 (May 20-23, 2012, Nuremberg, Germany), SGS-2012 (September 11-15, 2012, Cracow, Poland), ISQL-2012 (September, 27-30 2012, Halkidiki, Greece) and TCM-2012 (October 21-26, 2012, Hersonissos, Crete, Greece). In these meetings, over 30 Action speakers from at least 20 COST countries were involved with a large participation as target audience in



Dr. Michele Penza

all workshops. In this **Newsletter**, we will give an update on the outcome of these workshops.

The COST Action TD1105 will hold the first Scientific Meeting including Working Groups Meeting and Management Committee Meeting at ENEA Headquarters, Rome (Italy), December 4-6, 2012.

I hope that you are encouraged to participate in this open and flexible COST Action TD1105 EuNetAir to extend our Pan-European R&D network. If you wish to join us and to be included in the Action mailing list, please contact us via the website www.cost.eunetair.it (coming soon) and we will keep you informed.

On behalf of Action management committee, I would like to thank ALL Action participants for their valuable scientific work, kind availability and great enthusiasm that will make our Action very successful!

Dr. Michele Penza
Action Chair

Editorial

Foreword from Editor-In-Chief

EuNetAir is a great chance for the European research community in the field of New Sensing Technologies for Air-Pollution Control and Environmental Sustainability to cooperate closely and to bring joined ideas forward. The **Newsletter** shall be seen as a tool to inform about news in this R&D field and to disseminate briefly latest results, especially with respect to commercialization. Aside from news from Working Groups and Special Interest Groups, we will therefore also publish briefly interesting research results in this research field and we will point to activities and conferences in the field of EuNetAir.

This first issue of the **Newsletter** would not have been possible without the contributing authors. However, the most time-consuming task was to coordinate everything. This task has been undertaken by Daniela Schönauer-Kamin. Thank you for your assistance. I would also like to express my thanks to Dr. Jaroslaw Kita and



*Editorial Team (University of Bayreuth, DE)
Daniela Schönauer-Kamin, Prof. Ralf Moos, Dr. Jaroslaw Kita*

Dr. Fabio Galatioto for their substantial support with layout and typesetting.

I sincerely hope that you find this Newsletter helpful and that it will serve as a nucleus for future joint R&D projects.

Prof. Dr.-Ing. Ralf Moos
Editor-in-chief

Focus On

E. Weijers

AirMonTech - Current and Future Air Quality Monitoring in Europe

AirMonTech



How to monitor urban air quality (AQ) in Europe in future? This and other questions will be answered by "AirMonTech", an EU FP7 project. (<http://www.airmontech.eu>)

With the revision of the European thematic strategy "Clean Air for Europe" and discussion on a revision of the AQ Directive coming up beyond 2013, AirMonTech develops recommendations for future urban air quality monitoring and strategy. Its consortium compiles information on air quality metrics as well as current and future measurement techniques. All kinds of documents regarding pollutant metrics, instrument performance, tests, operating procedures, etc. are stored in the specifically-designed database which is freely available in the web (<http://db-airmontech.jrc.ec.europa.eu>). It offers a unique and valuable source of knowledge for all stakeholders, such as monitoring networks, NGOs, manufacturers, developers, policy advisers, and all interested people.

Simultaneously, AirMonTech develops a research road map with recommendations for future AQ monitoring in the EU. It contains a development strategy for new devices and technologies, evaluation steps for new regulatory metrics, and discusses current and alternative monitoring strategies. Answers will be given to questions like: What are the most suitable particulate metrics for health effects? How should regulation be adapted to improve the usability of data beyond compliance measurements? How to balance the standardization and instrument certification with innovation and flexibility?

Database and progress so far will be presented and evaluated at the 3rd AirMonTech workshop at March 4-5, 2013, in Duisburg, Germany. Program and further details will soon be made available on our website. Registration for the workshop starts in January 2013. A separate COST Action EuNetAir workshop will be held directly after the AirMonTech workshop on March 6, 2013, also in Duisburg.

The following and final AirMonTech conference will take place in Brussels at May 16, 2013. More information will be given in due time on the AirMonTech website (www.airmontech.eu).

News from
Ad-Hoc
Groups

I. Steinberga

Gender Balance

In the action (TD1105) about 20 % of the participants are female, which is in line with the fact that technological and scientific sector of this action is male-dominated. In order to approach a 50 % gender balance, for example

the Management Committee Vice Chair, Prof. Anita Lloyd Spetz, is female. To achieve better gender balance in Working Groups, female researchers are encouraged to participate in Short Term Scientific Missions, Training Schools and the entire COST Action.

News from Working Groups

Working Group 2 - A. Schütze

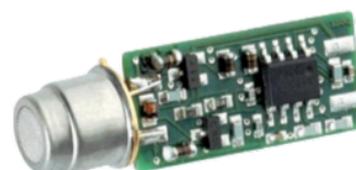
Sensors, Devices and Systems for AQC

The low-cost and ubiquitous measurement of air quality is essential for health and well-being of EU citizens. Today, air quality is generally monitored in process industry, e.g., in petrochemical industry, or in city centers. Here pollution is an issue. In the future, we need to measure various gases at many more locations at much lower cost. WG 2 will review the state-of-the-art in sensor elements, devices, and systems, especially based on micro and nano technologies. Microstructured sensor substrates based on CMOS, high temperature CMOS, and SOI technology, as well as nanomaterials such as nanowires and nanotubes for high sensitivity will be reviewed. Further developments are needed to address the issues of AQC and in particular the reliability of the sensors, ultralow power consumption and wireless interfaces to control systems. One approach is to modulate sensor devices thermally for low power detection of VOCs and to consider smarter interface circuitry. By smart design of devices and systems, the Action hopes to initiate a new generation of ubiquitous AQC systems.

To facilitate this approach, WG2 will address the following aspects:

- Sensing layers and transducers (in close cooperation with WG1)
- Active control of sensors elements

- Multi-sensor integration
- Low power technology
- Networking (both technology and protocols)
- Data processing



We suggest the following nomenclature to clearly identify the different levels in a complex sensor system or network:

- sensor element:** basically the smallest building block combining sensing layer and transducer;
- sensor module:** sensor element with electronics for operation and signal read-out;
- sensor node:** combining one or more sensor modules with on-board data processing and communication;
- sensor network:** several sensor nodes (of similar or different technologies) combined with additional data evaluation (correlation, mapping, visualization etc.).

News from Special Interests Groups

Special Interest Group 1 - M. Alvisi, F. Udrea

Network of spin-offs

The **Special Interest Group 1** – Network of spin-off – involves at present eleven spin-off and/or start-up companies from eight different COST countries. These companies carry out activities related to four principal Working Groups of the Action: (i) Sensor materials and nano-technology, (ii) Sensors, devices and Systems for AQC, (iii) environmental measurements and air-pollution modeling, (iv) protocols and standardisation methods.

The network encourages knowledge transfer between the institutions involved and aims to facilitate project partnerships to boost exploitation of the research results and to promote new avenues and business models based on advanced technologies for green economy and environmental sustainability.

The proposed main objectives are:

- Contribute to state-of-the-art by focusing on actual technology needs, future perspectives, integration possibilities, standards, protocols and guide-lines for future agenda
- Finding and engaging similar or complementary industrial organizations (i.e., spin-offs, start-ups) in the EU area involved in the fields covered by the Action
- Define and propose new mechanisms for cooperation for EU spin-offs SME
- Encourage knowledge transfer in the four areas as well as promoting innovation in research and proposing future agenda

During SIG1 session in Rome (December 5th), the group - after a presentation of each participant - will define the main objectives and priorities, the activities within the group and the final deliverables.

News from Non-Cost Partner

M. Meyyappan NASA Ames Research Center

The Center for Nanotechnology at NASA Ames Research Center (Moffett Field, CA, USA) conducts research in the areas of nano-materials and application development for chem, bio and radiation sensors, nanoelectronics, optoelectronics and energy storage devices. The chemsensor group, headed by Dr. Jing Li, has been working on a nano chemi-resistive sensor since 2002. This sensor system has been flight-tested twice and demonstrated for the sensitive detection of

about 15 gases/vapors to date with applications to planetary exploration leak detection in crew vehicles and cabin air quality monitoring. Integration of the sensor chip in a mobile phone, sensor networking and system development have been demonstrated. This expertise will be valuable to the EuNetAir. The benefit to NASA Ames group will be the opportunity to learn about environmental air quality monitoring, standards, current status of technology etc., which will allow us to extend the capabilities of our system to meet this important need.

Science & Tech Talk

A. Schütze Volatile Organic Compound Indoor Discrimination Sensor – MNT-ERA.NET project VOC-IDS

The project develops a new generation metal oxide gas sensor (low power and low cost) associated with smart heater management and data processing in identify and evaluate the concentration of carcinogenic and toxic VOCs in the ppb-range like Formaldehyde, Benzene, CO, NO₂ and Naphthalene (high priority) in indoor environments.

People spend more than 90% of their life in closed environments and buildings are becoming leak proof to reach low energy consumption performances. Inversely, the indoor VOC pollution steadily increases and requires ventilation control (renew indoor air) by

low cost VOC sensors, able to detect and evaluate individually in each room VOC concentrations. The smart sensor shall be part of a new generation Indoor Air Quality Sensor (IAQS).

The targeted innovation is to modulate the sensitive layer temperature to identify and evaluate the concentration of the most significant VOC. A new membrane type ceramic substrate with 10 μm thickness reduces power consumption and thermal time constants. Data processing based on pattern recognition techniques are used to identify relevant gases in the ppb-range against complex background situations.

The expected result is a sensor system based on one or two low cost sensors, probably with multiple sensing layers, able to identify and quantify the most relevant indoor VOCs with a recognition rate of over 90% allowing for efficient air renewal.

A. Lloyd-Spetz Collaboration within EuNetAir Linköping – Oulu – Saarbrücken

A new collaboration was started between three universities about two years ago, Linköping University, Sweden, University of Oulu, Finland and Saarland University, Germany. All of them are now partners in EuNetAir, which has already made the collaboration more active for example through more meeting points.

The collaboration regards both gas sensors and particle sensors. Linköping University develops the silicon carbide based FET gas sensors, University of Oulu metal oxide based gas sensors processed by PLD, pulsed laser deposition, technology, while Saarland University employs both kind of sensors in smart sensing, e.g. temperature and bias cycling with advanced data

evaluation, which results in e.g. improved selectivity.

The joint effort between all three universities is needed for the development of a portable particle detector, whereby for example detection of content of particles is performed through heating particles and detection of the emitted species by a gas sensor array. We are now strengthening the project through new connections to expertize from other partners in EuNetAir.

Saarland and Linköping Universities are also members of the EU research school DocMASE through a joint PhD student. He performs his PhD studies and will present his thesis at both universities, according to the program in this research school.

The project was presented at the COST session at IMCS 2012 in Nuremberg and a publication is now available online under [doi: 10.1016/j.snb.2012.10.078](https://doi.org/10.1016/j.snb.2012.10.078).

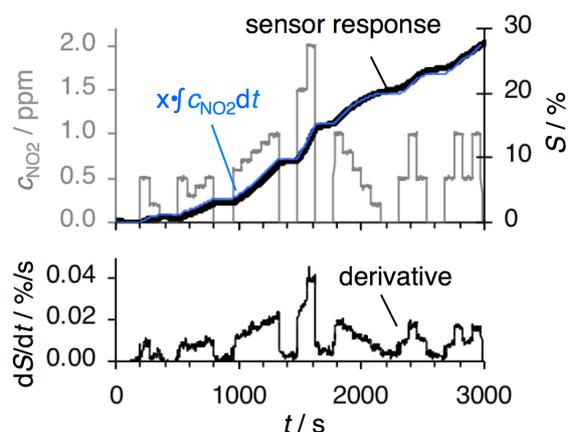
Science &
Tech Talk

A. Groß, R. Moos

Dosimeter-type but instantaneous low level NO_x detection for Air Quality Monitoring

The long-term detection of NO_x in the sub-ppm range and especially the mean values and peak concentrations are of particular interest for air quality monitoring. However, mean values determined by averaging noisy sensor signals are inaccurate. With the accumulating NO_x sensor, a new sensing principle is presented enabling the direct reliable amount detection with additional information about the instantaneous concentration. Like in a dosimeter, NO and NO₂ molecules are accumulated in a sensitive carbonate-based layer in a diffusion-controlled process as nitrate. While the resistivity correlates linearly with the total exposed NO_x amount or dose, the signal derivative reflects the curve of the actual concentration (fast sensor response). For sufficient periods, the low level accuracy is increased since even small concentrations contribute to the signal due to chemical sorption. In periodic thermal regeneration periods, the sorption capacity is recovered and the sensor's zero level is reset for the proximate sensing period (no baseline drift). The figure demonstrates the suitability of the accumulating sensor to monitor the EU immission legislation 1-hour NO₂ threshold of 200 µg/m³ (0.1 ppm in average) for

almost four hours. The response S increases in NO₂ being proportional to the integral of the concentration c_{NO_2} and the total amount, while the derivative dS/dt corresponds to c_{NO_2} .



For more information, see for instance:

A. Groß, G. Beulertz, I. Marr, D.J. Kubinski, J.H. Visser, R. Moos, Dual Mode NO_x Sensor: Measuring Both the Accumulated Amount and Instantaneous Level at Low Concentrations, *Sensors*, 12, 2831-2850 (2012), doi: 10.3390/s120302831.

M. Brini

Dioxins Nano-Sensors: cheap, low power, wireless dioxins NANO-sensors for real-time distributed contamination monitoring

Despite the increasing dioxin contamination and the well-known risk to our health, nowadays environmental monitoring of dioxins is still mainly focused on expensive and spot-sampling-based chemical analyses. There is a clear need for an inexpensive, continuous and real-time monitoring system. Several projects proved Wireless Sensors Networks to be effective in pollutant monitoring, relying on a new generation of cheap and low power transducers. Two years of researches led us to investigate and work with biosensors as a possible solution. Several positive results are strongly encouraging to further move on with research in order to develop a first prototype of the first biosensor for dioxins. So far, extensive research has been conducted to identify the best candidate. An enzyme with the right detection characteristics has been identified and already modified

improving its reactivity against the POPs. While some challenge is still ahead of us, we are optimistic to successfully test a prototype in the nearest future.

Project team:

Francesca Bosco
Biologist Researcher - Politecnico di Torino - IT

Marco Brini
COST Action EuNetAir Expert (Innovative environmental systems & Internet of Things) - CH

Alessandro Chiadò
Biologist - Politecnico di Torino - IT

Luca Marmo
Industrial Chemical Researcher - Politecnico di Torino - IT

Luca Varani
Structural Biology Group Leader - IRB - CH

Events

IMCS 2012

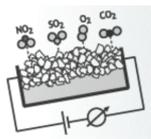


Past EuNetAir Events 2012

Twelve invited speakers contributed to two special EuNetAir sessions that were arranged as an inclusion into the **14th International Meeting on Chemical Sensors (IMCS)**, held from May 20 to 23, 2012, in Nuremberg, Germany, hosted by Prof. Ralf Moos. The every two years held IMCS conferences are the world's largest inter-disciplinary forum for all aspects of Chemical Sensors. In 2012, 507 contributions from 43 countries from all over the world were presented. Since it is one of the missions of the IMCS to bring advanced science in the sensor field in close contact to market needs, the 2012 IMCS was combined with the SENSOR+TEST expo, the world's largest trade fair on sensors.

The EuNetAir sessions were chaired by Prof. Giorgio Sberveglieri and by Dr. Michele Penza, head of the management committee and initiator of this special COST Action. Dr. Penza started his introductory talk with an overview on the COST Action TD1105 EuNetAir. The entire conference program can be found under <http://www.imcs2012.de>. All conference proceedings that include all EuNetAir contributions can be downloaded from the website of the German Sensor Association AMA, the organizer of conference and expo (<http://www.ama-science.org/>). It is noteworthy to mention that the EuNetAir sessions were all well attended, regularly over 150 participants listened to the twelve invited talks.

SGS 2012



An open special session devoted to **"Nanostructures & Sensing Technologies for Environmental Gas Sensors"** was included to the **VIII International Workshop on Semiconductor Gas Sensors (SGS)**, held from September 11 to 15, 2012 in Cracow, Poland. The Special Session was chaired by Prof. Eduard Lobet and Dr. Michele Penza. The event focused on environmental hot-issues by six Speakers from five COST countries including an overview

of the COST Action TD1105 EuNetAir from chair Dr. Penza. A significant participation from several European researchers (about 45-50 involved persons) attending to SGS-2012 also visited the special session.

The **Open Special Session** was aimed to provide information on the current state of semiconductor gas sensors, on nanostructured materials for gas sensing, and on new sensor technologies, advanced nanostructures for gas sensors, functional sensing materials, and new sensing concepts for air quality control.

ISQL 2012

A tutorial session **"Environmental Sensors for Air Quality Control Applications"** was organized within the frame of the 8th AIAI Conference and the 3rd Intelligent Systems for Quality of Life information services workshop (ISQL) held from September 27 to 30, 2012 in Halkidiki, Greece. 4 Speakers from 4 COST Countries of TD1105 EuNetAir including an Overview of the COST Action TD1105 from Chair attended to ISQL-2012.

The session chaired by Dr. Michele Penza and Prof. Kostas Karatzas was attended by several European researchers (about 25-30 involved persons) attending to ISQL-2012.

The **tutorial** was aimed to provide to the scientific community of Computational Intelligence and Quality of Life Information Services, as well as to anyone else interested, with information on the current state of play in new sensor technologies and new sensing concepts.

TCM 2012



An open satellite workshop **"Materials, Nanostructures and Technologies for Environmental Sensors"** was organized during the **4th International Symposium on Transparent Conductive Materials (TCM)**, held from October 21 to 26, 2012 in Hersonissos, Crete, Greece and chaired by Dr. Michele Penza, Prof. Juan Ramon Morante, and Prof. Giorgio Sberveglieri. The event was focusing on environmental hot-issues by four speakers from four COST countries of the TD1105 EuNetAir including an overview of the COST Action TD1105 from chair Dr. Penza towards large and

specialized target audience with high benefit for COST Action TD1105 and a significant participation from several European researchers (about 30-35 involved persons) attending to TCM-2012.

The **Workshop** provided information on the current state of play in new sensor technologies, advanced nanostructures for gas sensors and new sensing concepts not only to the scientific community of "Smart Materials and Nanostructures" but also to anyone else interested in that topic. The workshop was based on research results achieved by members of the COST Action TD1105 EuNetAir and is part of the Action's efforts for dissemination of results and for cross-domain scientific collaborations.

Events

Current Trend

Current trend in the solid-state sensing technology is the development of nano-materials and nanostructures with novel functionalities and innovative properties at the nanoscale for high-performance chemical sensing. In this direction, great efforts are conducted to fabricate environmental sensors with advanced sensing nanostructures and high-resolution transducers coupled to proper

electronic interfaces and new algorithms of pattern recognition and signal processing.

The key role for high-performance environmental sensors and sensor-systems is the engineering of sensing devices, ICT hardware, ad-hoc software/firmware, emerging transducers and sub-systems to develop air quality control applications with ubiquitous and mobile sensor-systems, including participating sensing and wireless sensor networks.

Announcements

M. Viana

Social ESRs Scientific Network

The open group "EuNetAir" was launched on LinkedIn in October 2012. The aim of this group is to promote connections between EuNetAir COST Action's ESRs, with the objective to create a community connecting ESRs for current and

future science and technology activities on AQC technologies. Invitations were sent out to 21 Action participants and members, which has resulted in its nine participants to date. The EuNetAir group is open to internal (within the Action) and external posts and discussions.

J. Theunis

Short Term Scientific Missions

EuNetAir has launched a call for tender for Short-Term Scientific Missions (STSM) to Institutions of the participating European Countries.

The goal of the exchange visits is to train Early Stage Researchers in foreign laboratories, to generate new knowledge related to COST Action

topics, to support career development of young researchers and to support networking of experienced scientists.

Interested researchers can apply for a grant for a visit of one week (5 working days), or 1 month. The grant will cover travelling costs and subsistence. The full text of the call can be downloaded on the website (www.eunetair.it).

Upcoming Events

Air Quality Monitoring - Opening opportunities through new technologies and data analysis
London, December 12-13, 2012
www.aamg-rsc.org

3rd AirMonTech Workshop on "Air Quality Monitoring Technologies for Urban Areas"
Duisburg, March 4-5, 2013 in conjunction with the COST Action EuNetAir
www.airmontech.eu

Pittcon with Session in Environmental Analysis
Philadelphia, March 17-21, 2013
<http://pittcon.org>

Sensor und Test - The Measurement Fair and Sensor Conference
AMA – Sensor und Test – May 14-16, 2013
<http://www.sensor-test.de>
<http://www.ama-science.org/ama-conferences-2013/>

Transducers 2013 and Eurosensors XXVII
Barcelona, June 16-20, 2013
<http://transducers-eurosensors2013.org/>

1st International Workshop of COST Action TD1105 on New Sensing Technologies and Transducers for Air Quality Control
Barcelona, June 20, 2013

3rd Management Committee Meeting of COST Action TD1105
Barcelona, June 21, 2013

EuNetAir

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EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



Newsletter COST Action TD1105 EuNetAir

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