European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir

FOURTH INTERNATIONAL ACTION WORKSHOP on Innovations and Challenges for Air Quality Control Sensors

Vienna (Austria), 25 - 26 February 2016
hosted at FFG - Austrian Research Promotion Agency - AT COST Association
Sensengasse 1, 1090 Vienna, Austria

organized by
Materials Center Leoben Forschung GmbH

co-supported by
Techkonnex - High-Tech Promotion

AGENDA

25 February 2016 - Thursday

09:00 - 18:00  REGISTRATION
09:30 - 10:00  Welcome Address
10:00 - 11:00  Session 1: Plenary Session
11:00 - 11:30  Coffee Break
11:30 - 13:00  Session 2: Oral Presentations
13:00 - 14:30  Lunch
14:30 - 16:00  Session 3: Oral Presentations
16:00 - 16:30  Coffee Break
16:30 - 18:00  Session 4: Oral Presentations
20:00 - 23:00  Social Dinner

26 February 2016 - Friday

09:00 - 16:00  REGISTRATION
09:30 - 11:00  Session 5: Oral Presentations
11:00 - 11:30  Coffee Break
11:30 - 13:00  Session 6: Oral Presentations
13:00 - 14:30  Lunch
14:30 - 16:00  Session 7: Poster Presentations
16:00 - 16:30  Discussion and Coffee Farewell
16:30           Closure of Meeting
### Thursday, 25 February 2016

**COST Action TD1105 EuNetAir WORKSHOP**

hosted at FFG - Austrian Research Promotion Agency - AT COST Association

Sensengasse 1, 1090 Vienna, Austria

<table>
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<th>Time</th>
<th>Session</th>
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<tr>
<td>09:00 - 12:00</td>
<td><strong>Welcome Address</strong>&lt;br&gt;Chairperson: Anton Köck, Local Organizing Committee Chair and MC AT Member - Materials Center Leoben Forschung GmbH (MCL), Leoben, Austria&lt;br&gt;Welcome: Austrian COST Association - FFG, Austria&lt;br&gt;Nicole Schmidt, Member of AT CNC COST Association, Austria&lt;br&gt;Welcome: Material Center Leoben Forschung GmbH&lt;br&gt;Anton Köck, Delegate MCL, Leoben, Austria&lt;br&gt;Welcome: COST Action TD1105 EuNetAir&lt;br&gt;Michele Penza, Action Chair, ENEA, Brindisi, Italy</td>
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<td>10:00 - 11:00</td>
<td><strong>Session 1 - Plenary Session</strong>&lt;br&gt;Chairperson: Anton Köck, Local Organizing Committee Chair and MC AT Member - Materials Center Leoben Forschung GmbH (MCL), Leoben, Austria</td>
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<td>10:00 - 10:30</td>
<td><strong>COST Action TD1105: European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability, Overview and Plans of COST Action TD1105</strong>&lt;br&gt;Michele Penza, Action Chair, ENEA, Brindisi, Italy</td>
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<td>10:30 - 11:00</td>
<td><strong>Air Quality Current Status in Europe</strong>&lt;br&gt;Cristina Guerreiro, EEA Report Leader, NILU - Norwegian Institute for Air Research, Kjeller, Norway</td>
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<td>11:00 - 11:30</td>
<td><strong>Coffee Break</strong></td>
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<td>11:30 - 13:00</td>
<td><strong>Session 2 - Environmental Informatics and AQ Sensors Calibration</strong>&lt;br&gt;Chairperson: Michele Penza, Action Chair - ENEA, Brindisi, Italy</td>
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<td>11:30 - 12:00</td>
<td><strong>Air Quality Modelling at Different Scales</strong>&lt;br&gt;Camillo Silibello, WG Member, Project manager, ARIANET srl, Milan, Italy</td>
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<td>12:00 - 12:20</td>
<td><strong>Challenges for Environmental Information Services Resulting from Sensors Integrated to Smartphones</strong>&lt;br&gt;Kostas Karatzas, Aristotle University of Thessaloniki, Greece</td>
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<td>12:20 - 12:40</td>
<td><strong>A New Approach for On-site Calibration and Calibrated Quantification of VOCs with Low-Cost Sensors</strong>&lt;br&gt;Andreas Schuetze, Action WG2 Leader &amp; MC Member, Saarland University, Saarbrucken, Germany</td>
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<td>12:40 - 13:00</td>
<td><strong>Noise-Based Techniques for Gas Sensing</strong>&lt;br&gt;Dionyz Pogany, Vienna University of Technology, Institute for Solid State Electronics, Vienna, Austria</td>
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<td>13:00 - 14:30</td>
<td><strong>Lunch Break</strong></td>
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NOISE-BASED TECHNIQUES FOR GAS SENSING

D. Pogany

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Random fluctuations or noise determine sensitivity of different kind of sensors. In particular, in nano-devices, which are promising due to their high surface to volume ratio, the relative noise (e.g., standard deviation of current fluctuations to mean current) increases with reduction of device dimensions. This is because less and less carriers participate in transport and thus small imperfections or low number of active surface sites modulate the current tremendously. Fluctuations in carrier number and/or carrier mobility can be considered. Noise is usually considered as detrimental factor in sensors as it decreases signal to noise ratio [1-3]. However noise can be considered as information carrier in sensors [4] and this idea led to the development of general concept of fluctuation enhanced sensing (FES) which has been utilized in particular for gas and biological sensing [5-6]. It has been proposed that different gas species can be selectively detected thanks to special spectral features in noise spectrum. This could lead to reduction of number of detecting elements in comparison to conventional electronic nose [7] concept which is based on DC or transient measurements in large array of detectors with different gas selectivity.

In frequency domain, the adsorption-desorption noise provides Lorentzian shape of power spectral density with a corner frequency determined by the time constant of adsorption-desorption process [8,9]. Lorentzian spectra attributed to adsorption-desorption noise have been measured in thin film [10-12] and graphene [13] sensors subjected to different gases and volatile species. If the relaxation/correlation time of fluctuations is broadly distributed, 1/f spectrum [14] can be observed [3,15].

In time domain, individual adsorption-desorption events result in discrete resistance switching which has been observed in graphene sheets subjected to different gas species [16]. Furthermore, higher order moment statistical analysis of fluctuations [6,17] and wavelet analysis of current waveforms [18] have also been used to find specific signatures of gases in gas sensors.

In this presentation, basics of noise, noise models and noise measurement techniques for FES will be first briefly introduced. Examples of noise studies in gas sensors, in particular FES via adsorption-desorption noise, will be shown. Finally a recent study of influence of air humidity on 1/f noise in CuO single nanowire gas sensors [15] will be presented. The observed rise in relative noise in humid atmosphere is attributed to increased surface potential fluctuations and related carrier scattering fluctuations due to random distribution of hydroxyl groups at the nanowire surface.

References:
Oral Presentation


