



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

COST Action TD1105

1ST TRAINING SCHOOL

Universitat de Barcelona, Spain, 13 - 15 June 2013

organized by UB, MIND-IN2UB - Dept. of Electronics and CSIC-IDAEA

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 1: 2012 - 2013 (*Ongoing Action*)



UNIVERSITÄT
DES
SAARLANDES

Christian Bur

Diplom Ingenieur / c.bur@lmt.uni-saarland.de



Linköping University
INSTITUTE OF TECHNOLOGY

Lab for Measurement Technology, Saarland University, Germany
Div. of Applied Sensor Science, Linköping University, Sweden

Expertise of the Trainee related to the Action

- Diploma in Mechatronics, focus on Microsystem Technology
- Working in the field of gas sensors (SiC-FET) since 2009
- Since 2011 joint PhD student at Saarland University, Germany and Linköping University, Sweden

Topic: “Dynamic Operation Mode and Advanced Signal Processing for Selectivity Enhancement of Gas Sensitive SiC-FETs”

- Dynamic operation of gas sensitive field effect transistors, e.g. temperature- (TCO), gate bias cycled operation (GBCO)
- Signal processing based on pattern recognition, e.g. Linear Discriminant Analysis (LDA)
- Detection of exhaust gases (NO_x) and VOCs

Current research activities of the Trainee (1/2)

- Project: VOC-IDS, (BMBF / MNT-ERA.net)
 - Optimization of micro- / nano structured gas sensors for indoor VOC detection
- Project: self monitoring of the sensor, (AiF-IGF)
 - Combination of EIS and temperature cycled operation (TCO)
- Combination of NDIR and PAS
 - For CO₂ detection
- Gas sensitive SiC - Field Effect Transistors
 - Dynamic operation for selectivity enhancement (virtual multisensor)
- Development of SiC-FET gas sensors
- Graphene sensors
- Methanol and ammonia sensors

www.lmt.uni-saarland.de

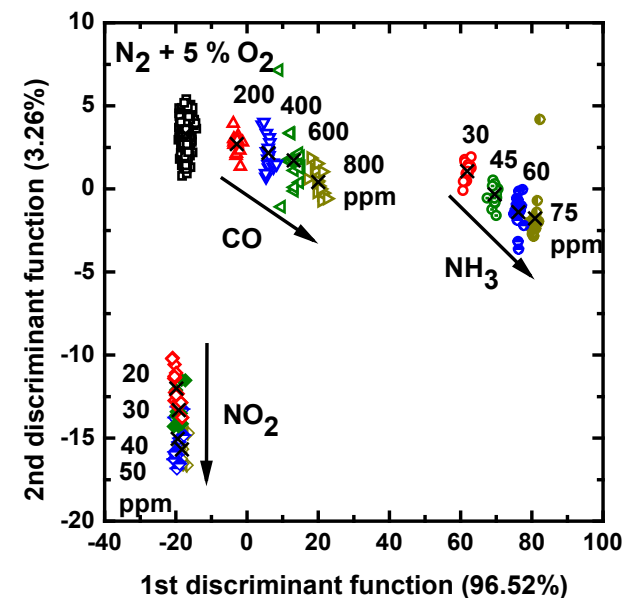
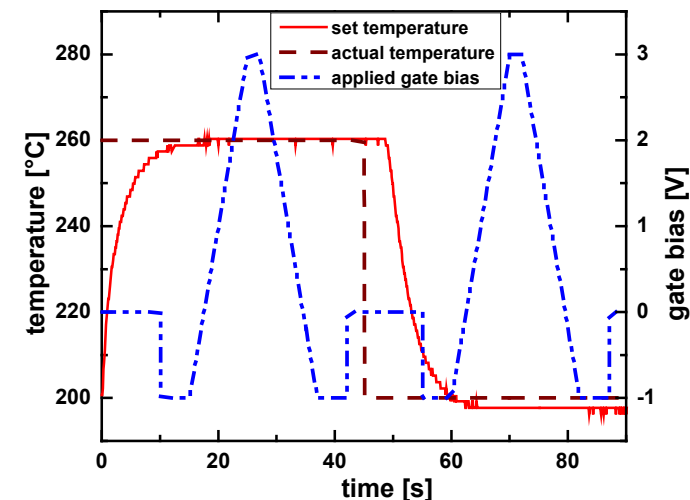
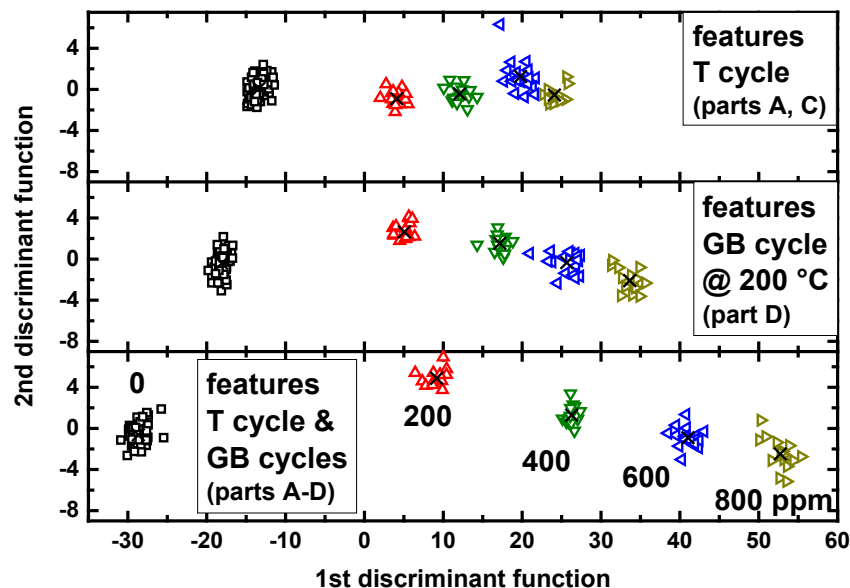
www.ifm.liu.se/applphys/applsens

Current research activities of the Trainee (2/2)

- Combination TCO and GBCO for selectivity enhancement
 - Both temperature and bias cycling increases selectivity
 - > further improvement by combination?
- Pattern recognition (machine learning)
 - Feature extraction/selection is the most important step
 - Besides LDA/PCA also Support Vector Machines (SVM)
- Detection of VOC in the low ppb range with SiC-FETs
 - Application: Indoor air quality
- Content of particle detection with SiC-FETs
 - Heat up particles and measure with a gas sensor what comes out

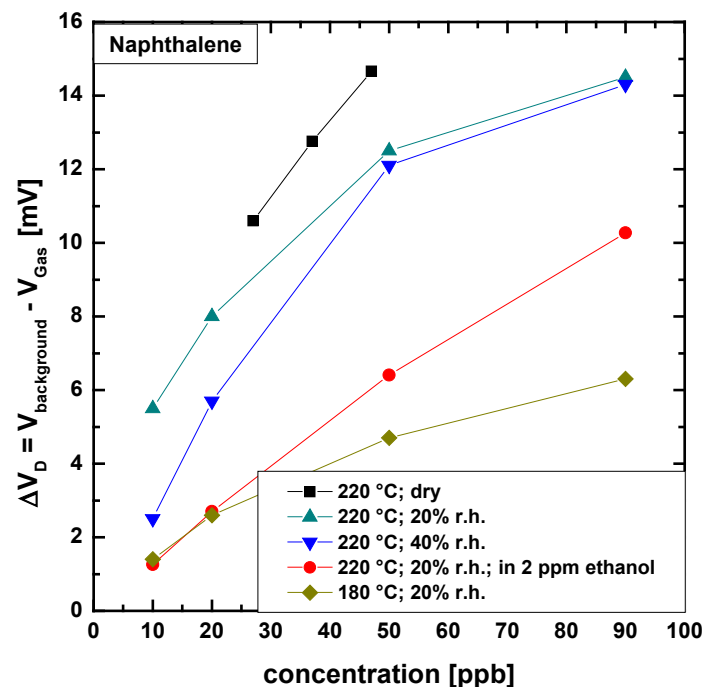
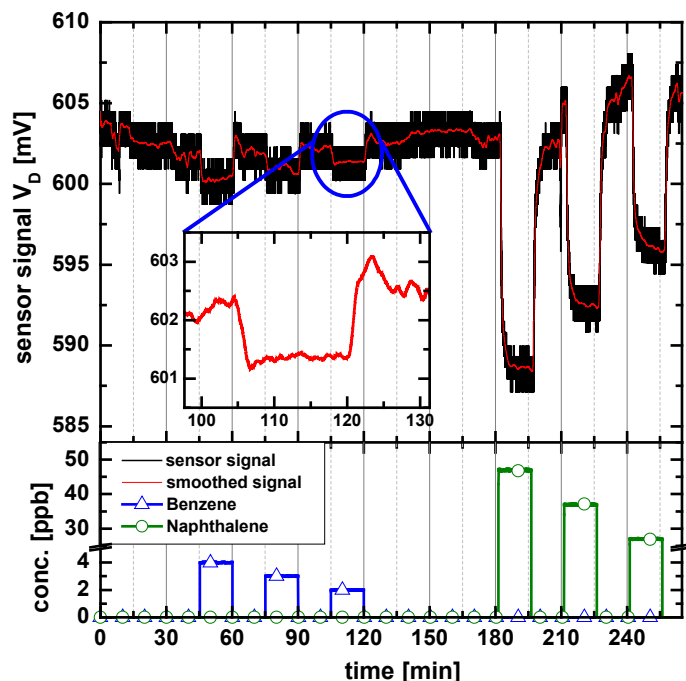
Achieved **RESULTS** and future activities

- Combination of TCO and GBCO
 - Increased selectivity
 - Similar results for quantification
 - For separation, features from both TCO and GBCO equally important
 - Signal processing still a challenge



Achieved **RESULTS** and future activities

- Detection of VOCs in the ppb range with SiC-FETs
 - Detection limit of a few ppb
 - Benzene, naphthalene and formaldehyde



CONCLUSIONS

- Selectivity of SiC-FETs can be enhanced by dynamic operation
- Combination of TCO and GBCO is possible
- VOCs detection in the low ppb range possible with SiC-FETs
- Signal processing is still a challenge
- Only small response towards VOCs
- Selectivity and stability needs to be improved