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swiss scientific initiative in health / security / environment systems

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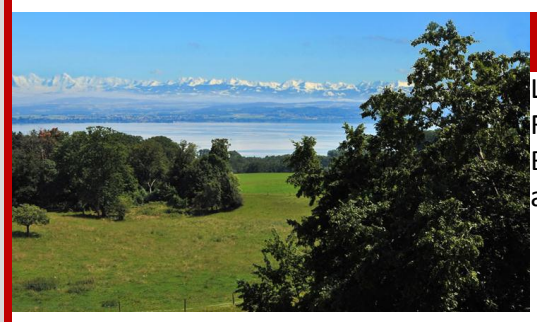
Post Workshop Report – Innovative Sensors

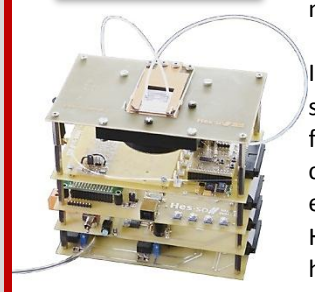


Last June (21-22), FSRM organized the fourth Nano-Tera workshop on Innovative sensors at at La Rouvraie, Bevaix, NE. Following experts from different fields, institutes and companies in Switzerland presented their research in related areas. By the means of this newsletter, we would like to share with you a very short brief of their presentations and achievements.

Prof. Martial Geiser
Hes-SO, Valis

LiveSense - *Micro fluidic stand-alone system*

LiveSense project aims for better monitoring our environment. The idea is to form a network of living cells as natural biosensors.



In his talk he explains about their latest development of a show-box size stand-alone system (as shown in left) with fluorescence detection. This system uses a 400µm x400µm cage for beads. The microfluidic block is positioned with an easy mechanical adjustment with excitation/detection. Here excitation is done by laser instead of LEDs. At the end he compared his system with fluorescence microscope.

Dr. Martin Wolf
University Hospital of Zurich

NeoSense - *Bringing light in tissue diagnostics: Sensors based on near-infrared spectroscopy and imaging*

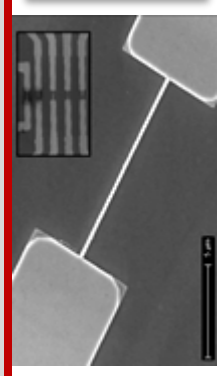
Starting with an insight in "lightning conditions" in our brain, Dr. Wolf presented how their sensors were used to measure happiness status of a sheep.

These sensors can diagnose tissue using light sensors based on near-infrared spectroscopy and imaging. He demonstrated how his state of the art miniature wireless non-invasive sensor take a variety of measurements including blood flow, O2 consumption, neuronal activity, dyes, water lipids cytochrome, etc of our brains.

The project NeoSense is focused on developing sensors for multi-parameter monitoring in critically ill newborns.

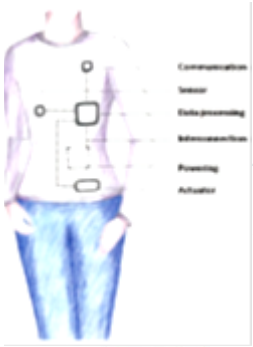
Dr. Michel Calame
University of Basel

NanowireSensor - *Dual-gated Si nanowire FETs for ion- and bio-sensing*



The aim of NanowireSensor project is to develop a silicon nanowire-based field-effect transistor sensor platform which is applicable to label-free multiscale screening with full electronic processing and read-out capability due to silicon integration. The plan is to work on nanowires etched directly into silicon.

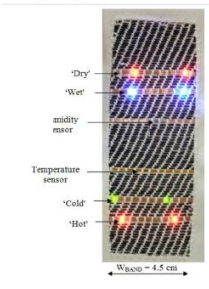
In his talk he discussed various aspects and findings of his research.. Starting with the basics of Ion sensitive FET for chemical and bio sensing, he explained the process of designing and fabrication of silicon on insulator (SOI) process for Si nanowire FETs. He further talked in detail about operation of these in liquid environment, pH sensing and up scaling issues. He ended his talk by shedding some light on other platforms for sensing like nanoparticles arrays and grapheme GFET.



Dr Stéphanie Pasche
CSEM

TecInTex - *Technology Integration into Textiles for Sensing*

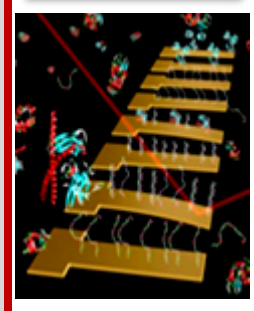
According to Dr. Stéphane technology integration in textiles is nessary for monitoring human body and environment. She also discussed its impact on Swiss textile industry.



Three types of tech fibers discussed in detail were e-fibers, e-strips and o-fibers (optical). Starting from the weaving techniques for e-fibers along with normal fibers using UV, she talked about Piezoresistive strain sensor fibers, their challenges and solutions. E-stripes are based on planar thin film technology, which integrates sensors, transistors, and ICs in < 0.5 mm stripes to be woven in to textiles. They experimented this to design Flexible gas sensor, Resistance temperature detectors, TFTs and LEDs. Finally she showed Bio sensing fibers and smart bandage for wound monitoring.

Dr. Harry Heinzelmann
CSEM

PATLiSci - *Cantilever Based Sensing for Cancer Research*



In an interactive talk he first gave a crash course about microscopy, puzzling the audience with obvious but tricky questions. He went in further details of Scanning Probe Microscopy, Atomic Force Microscopy and their different types.

Further, explaining catilever as a non-mechanical sensor as it only absorb molecules resulting in mechanical stress. This can be used for cancer by detecting mutant DNA (in liquid) by optical bean deflections and detecting VOCs (in gas) by piezoresistors. Last he presented his research and various tips and tricks related to PROBART, Force Spectroscopy, ArrayFM with optical readout and MINACEL.

Dr. Andreas Borgschulte
EMPA

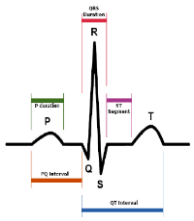
The Tank is empty

Dr. Andreas presented the problems and solutions for today's energy problems. Particularly with using Hydrogen as a fuel. In this talk he specifically talked about storage and absorption of Hydrogen.

With energy demands getting higher every day, we need an artificial energy carrier. In his sort and to the point presentation he discussed the issue of designing a Hydrogen storage gauge. His research is based on phenomena of change in optical characteristics of metal based on its absorbed Hydrogen content. He discusses various techniques including using optical fibers as Hydrogen fuel gauge.

Prof. David Atienza
ESL, EPFL

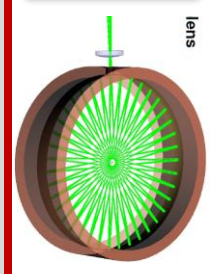
BioCS-Node - *System-Level Design of Ultra-Low-Power Architectures for Wireless Body Sensor Networks (WSN)*



He started by quoting that 50% of the death are mainly caused by Health Behaviour. In the presented research he uses electrocardiogram to diagnose ailments reflected by disturbances of the heart's electrical activity. For which they use Shimmer node platform. The goal now is to reduce the amount of streamed data and sampling cost. They use delineation and digital Compressive Sensing
(CS) for compression. At last he displayed enduser application developed with cooperation with Nokia and PRONAF, and 3-lead ECG running on iPhone in real time.

Dr. Lukas Emmenegger
EMPA

IrSens - *Continuous measurements of δ13C and δ18O in CO2 using quantum cascade laser spectroscopy*



Carbon dioxide is the main gas responsible for climate change. Depending on its origin, the isotopic composition of CO2 is slightly altered.
In his talk he presented a new sensor for continuous and high precision isotope ratio measurements of CO2 in the free atmosphere. This sensor is 8 cm in diameter and based on newly developed quantum cascade laser. robust and transportable apparatus to house this laser, which allows for continuous measurement on site with results automatically read and processed remotely in real-time.

Dr. Hans Peter Lang
University of Basel

PATLiSci - *A cantilever-based "nose" for medical and biochemical detection*

Dr. Land presents their design of an electronic sensor to analyze patient's breath for diagnosis. Diseases as serious as lung cancer, Acetone (Diabetes) or Dimethylamine (Uraemia) can be detected using breath analysis.

The sensor have eight cantilevers each coated with a different polymer. Polymer layer absorbs analyte, the amount of absorption is proportional to the swelling/bending of the cantilever. Thus recognizing the composition of the air.

Dr. Yves-Alain Peter
École Polytechnique de Montréal

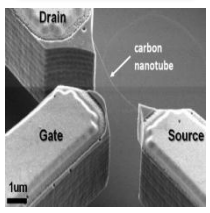
Multi sensing using integrated Fabry-Pérot cavities on chip

Initiating from an introduction to optical micro resonators, he explained the concept and fabrication process of Fabry-Pèrot cavities. He further demonstrated his research in application of these micro cavities. Applications include on chip and mass produce able Refractive index sensor, gas sensor, accelerometer, and force sensor.

His RI sensor has high sensitivity (~1000nm/RIU) and high resolution (10^-3 to 10^-5). While the gas sensors have detection limits <10 ppm. Accelerometer is capable of 2.2 µg resolution.

Dr. Cosmin Roman
Micro and Nano Systems, ETHZ

CabTuRes - *Tunable Carbon Nanotube Resonators for Sensing and Electronics Applications*



CabTuRes ia focusing on the integration of CNT resonators with CMOS circuits and zero level packaging. CNT resonators are very promising for sensing and electronics applications, but noise and nonlinearity need to be avoided for them to perform acceptably in ambient conditions.
CNT resonator's applications include, sensors: chemical, force, microscopy, strain, pressure, flowmeter, etc., electronics: V-controlled oscillator, RF detet., tunable filter.

Yves De Coulon
Neroxis

KAPTA™3000 - *Sensor Network and Solution to Manage and Secure the Drinking Water Distribution in Real Time*

KAPTA 3000 is a "all-in-one" probe which measures Chlorine, Temperature, Pressure and Conductivity of water. It's a miniaturized probe designed to retrofit in existing supply system. These probes communicates via GSM and/or radio (868 Mhz) for central data management and visualization.

On the tip it has a silicon chlorine sensor, conductivity and fouling measurement and pressure and temperature sensor.

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