

World Environment Day 2015-06-05



World Environment Day 2015
**Seven Billion Dreams.
One Planet.
Consume with Care.**
June 5

<http://www.unep.org/wed/wedchallenge/>

**Plastic pollution
are turning our
beautiful place
ugly, take action!
Jessica**



**To work harder on recycling and fight
harder to protect our planet lung The
Amazon. Stop smoking, support ONGs
on environmental issues.**

Laura Ballola

**I will make the world a
clean, green and happy
place to be**

Ilona de Graaff

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

COST Action TD1105

WGs and MC Meeting at LINKÖPING, 3 - 5 June 2015

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

Year 3: 1 July 2014 - 30 June 2015 (*Ongoing Action*)

New Methods for control of Nanoparticles in indoor versus outdoor environment



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 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



OULUN YLIOPISTO
UNIVERSITY of OULU



Toxic gas molecules and **PARTICLES** pose a threat to our health

Sensors systems for control are needed



Propellerplan släpper ut mindre föroeningar än jetplan.



Toxic substances include: NO_x , SO_2 , CO , O_3 , PAH/VOC, **PM_{10} , $\text{PM}_{2.5}$, PM_1**



Outline

- **Toxic particles**

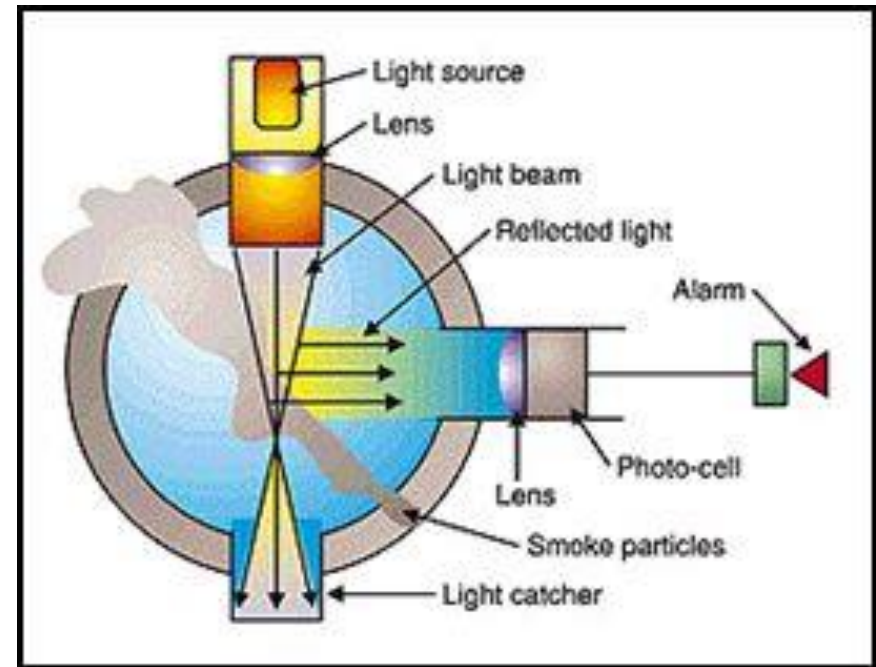
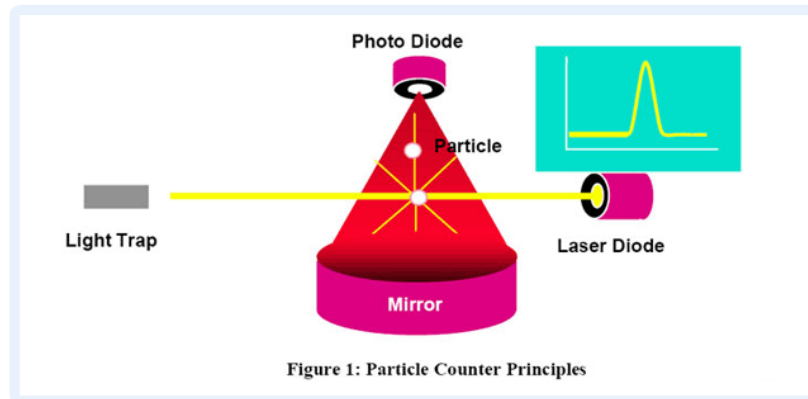
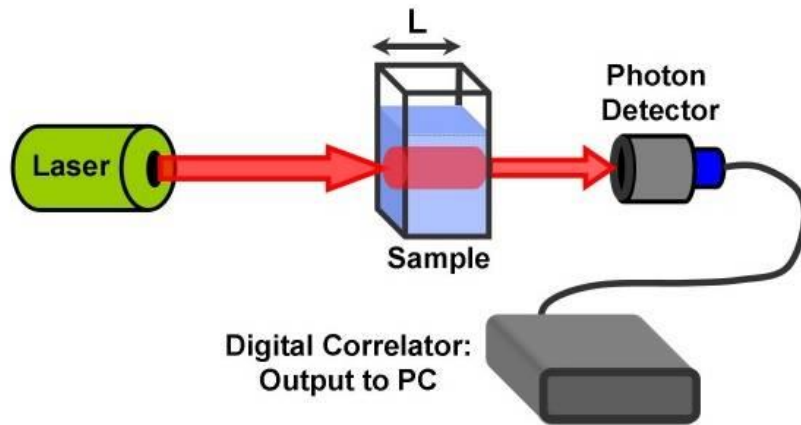
Monitoring of particles by

- **Heating and detection of emissions**

- **Integration of functionality in LTCC packaging**

- **The cell clinic, toxic effect of particles**

Optical particle detectors principles



Fire alarm

Particle detector, commercial device

Particle Sense P600



Measures PM1, PM2.5 and PM10

Particle detection, under development

Miniaturized device for the on-line monitoring of particles for

- Work places
- Public use

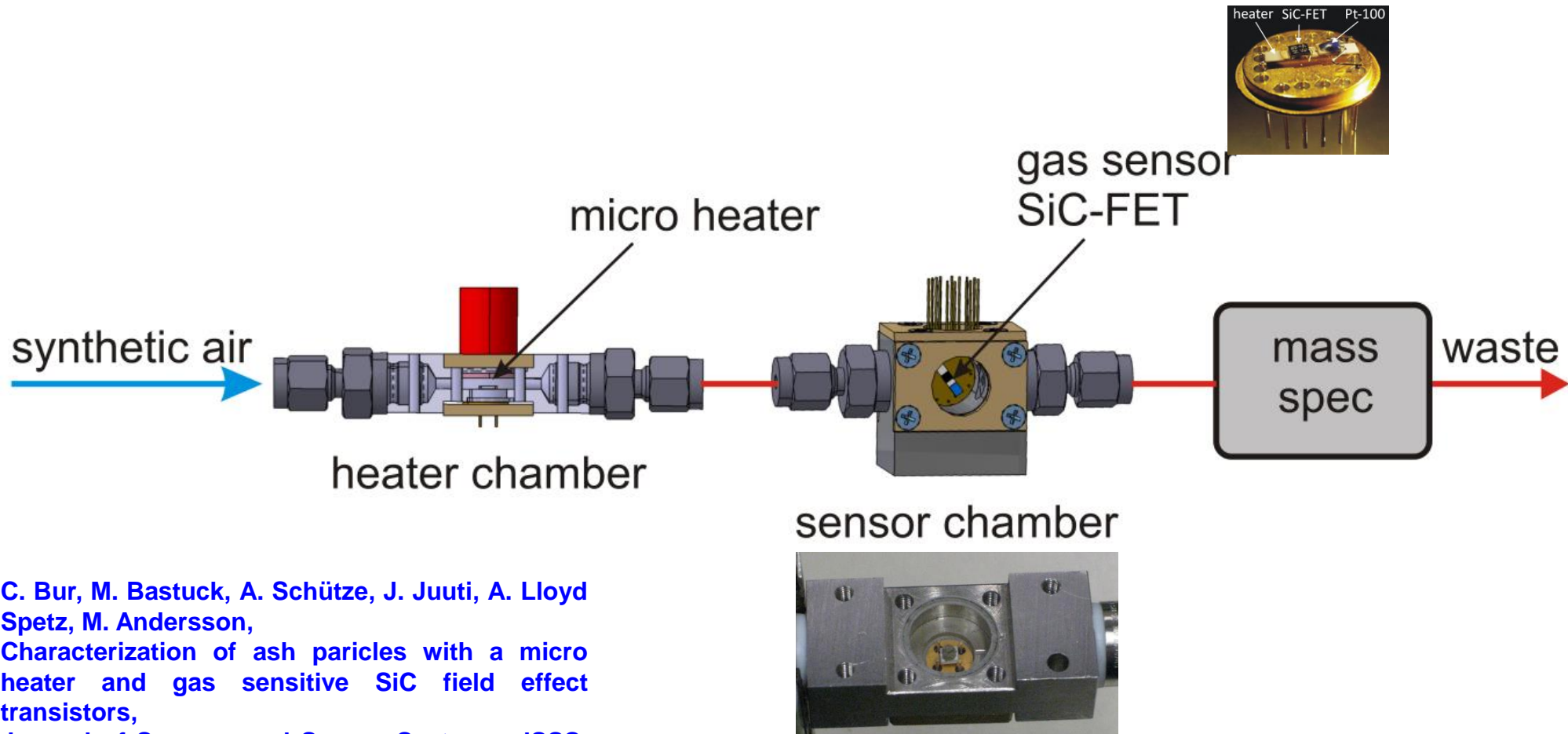


Giving information about particle

- number (concentration)
- Size
- Shape (needle like, asbestos like (branched needles))
- Content (CNTs containing Ni, Fe, Co has shown adverse effect in animal studies)

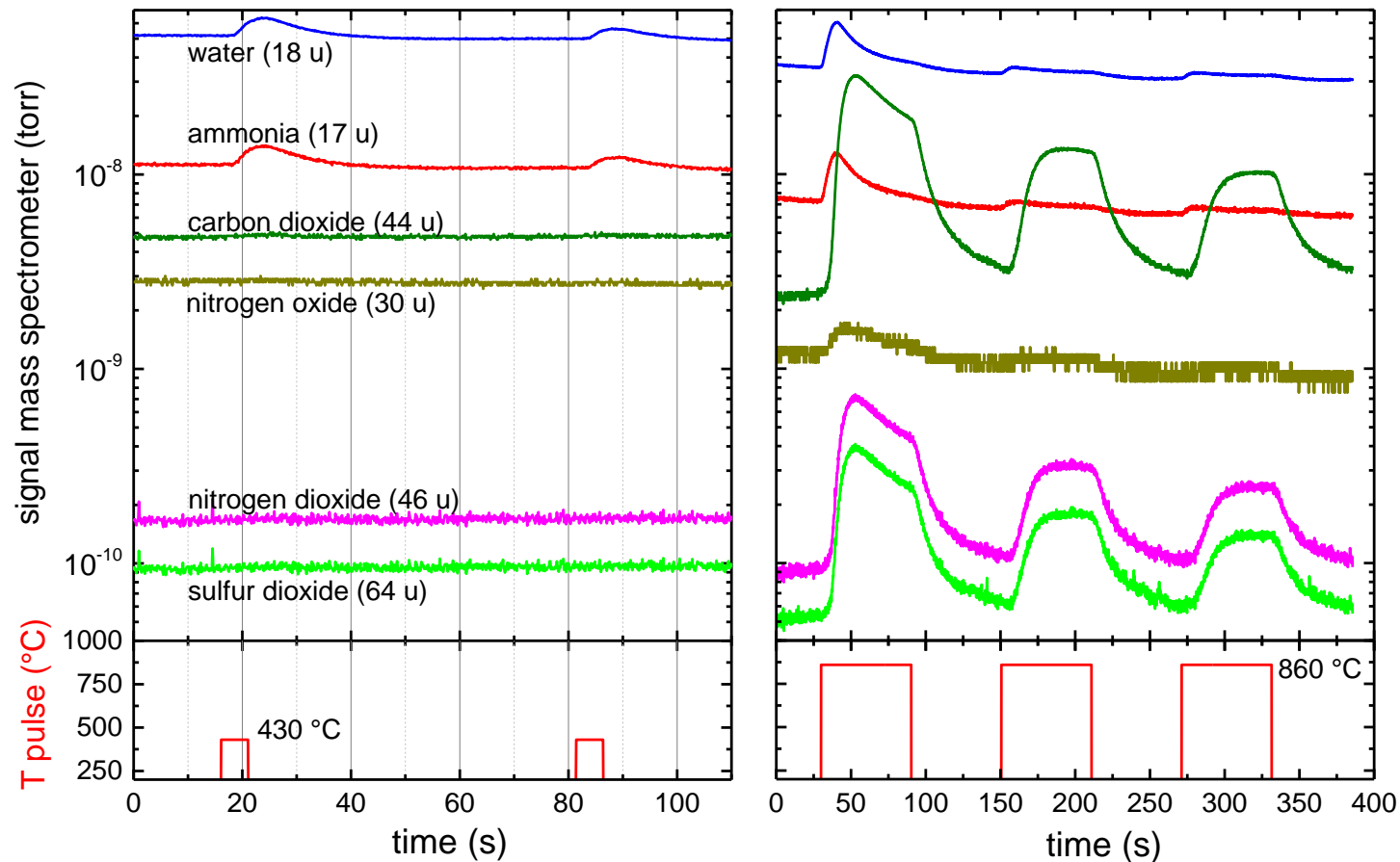
Since these parameters influence the adverse health effect of particles

Particle content measurement set up



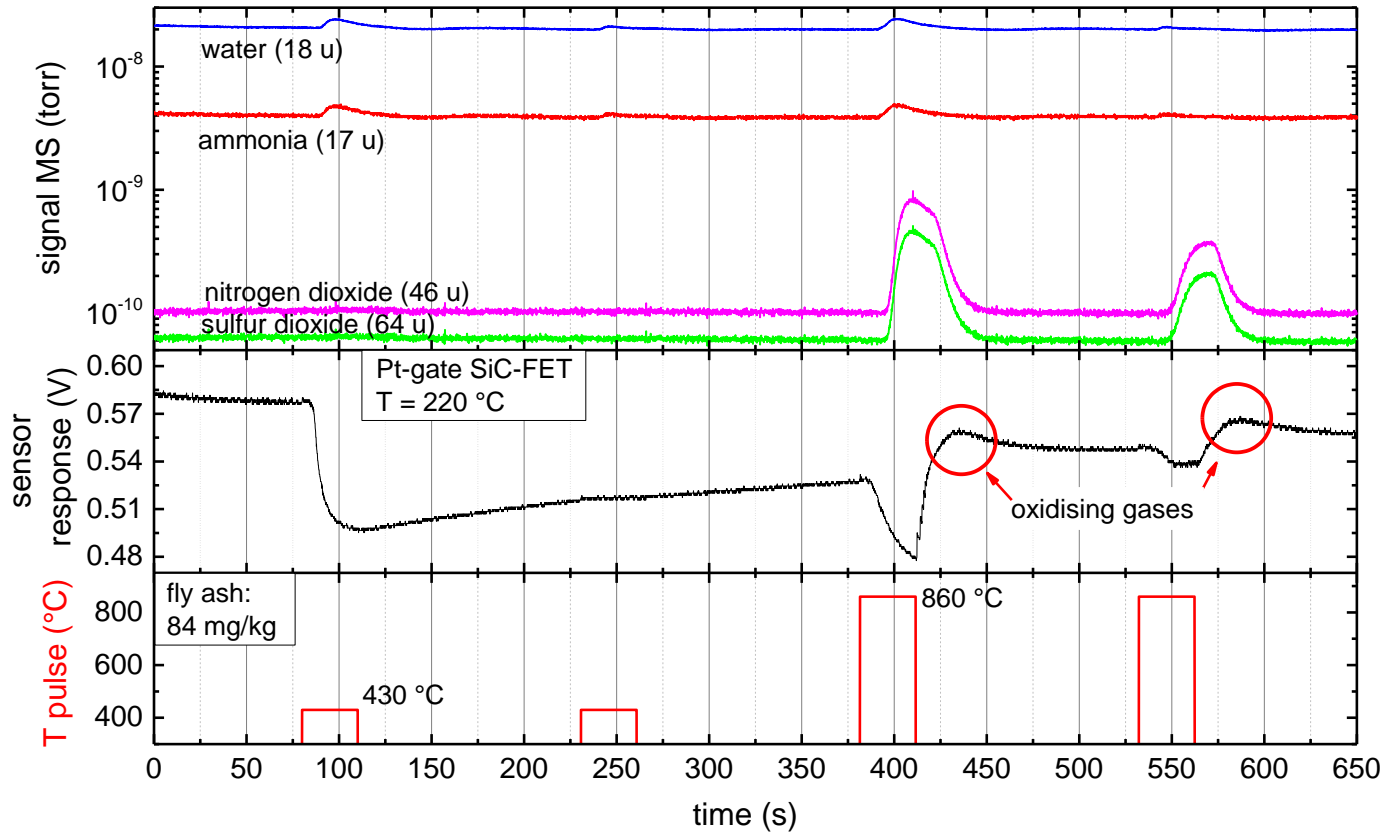
C. Bur, M. Bastuck, A. Schütze, J. Juuti, A. Lloyd Spetz, M. Andersson,
Characterization of ash particles with a micro heater and gas sensitive SiC field effect transistors,
Journal of Sensors and Sensor Systems, JSSS, 3 (2014) 305-313.

Detection of particle content



Mass spectra of fly ash with 84 mg/kg ammonia when heated to 430 °C (left) and 860 °C (right).

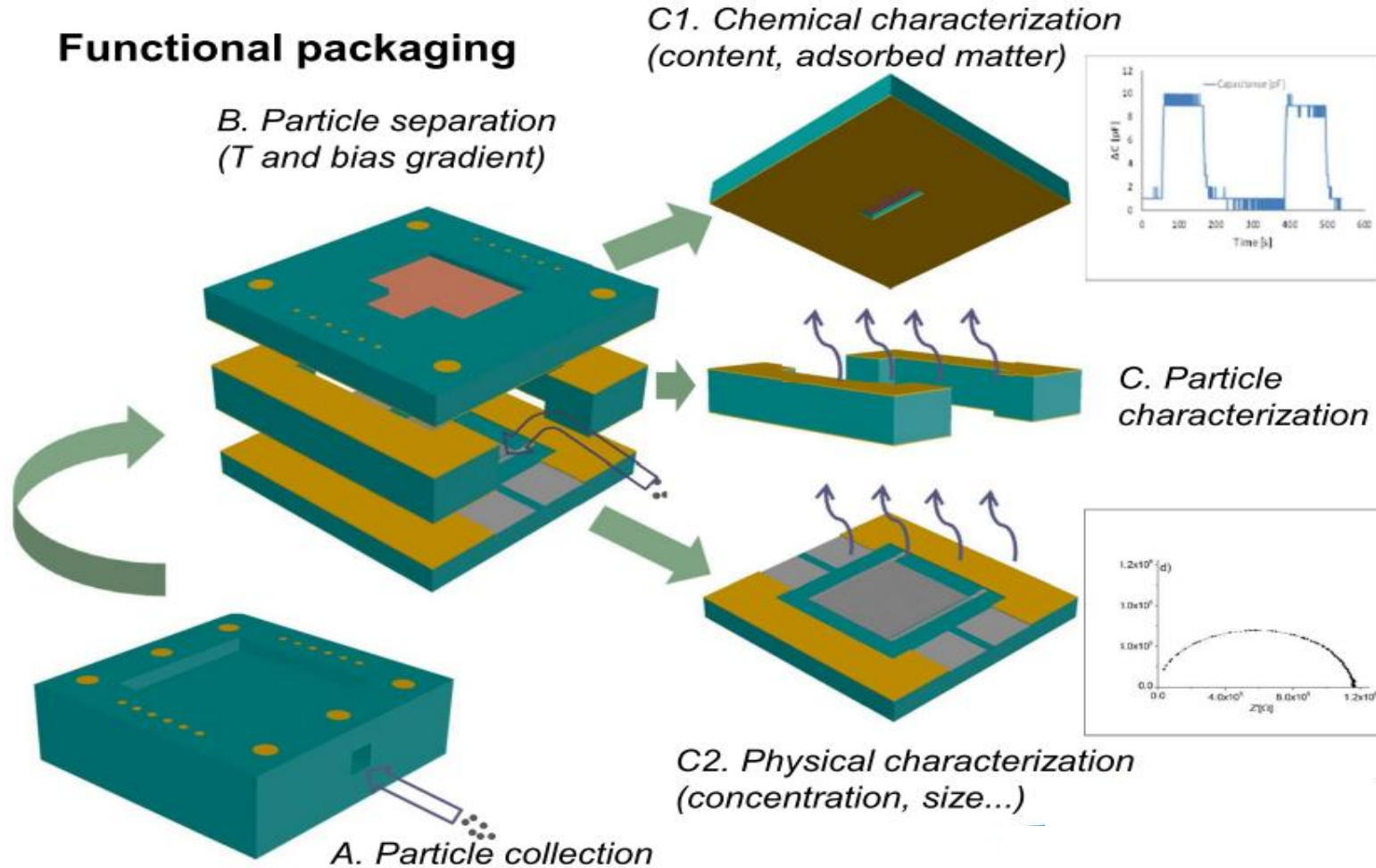
Detection of particle content



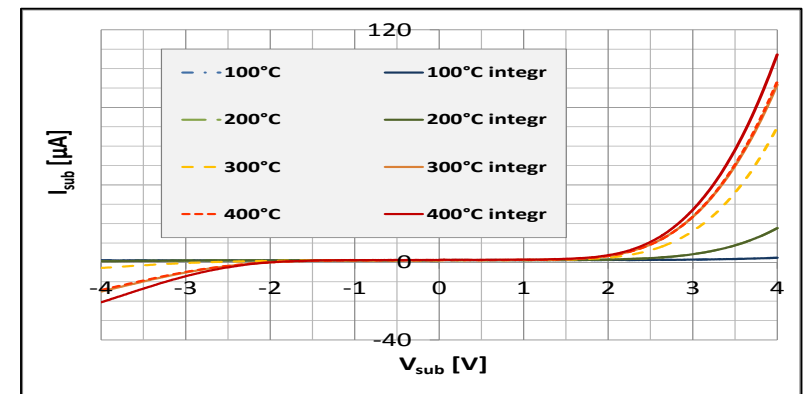
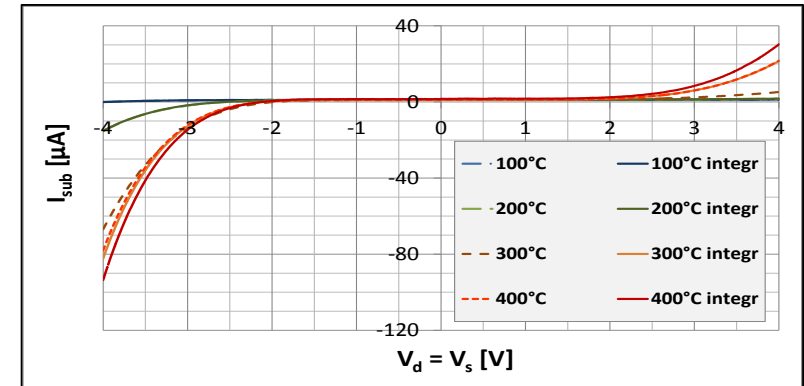
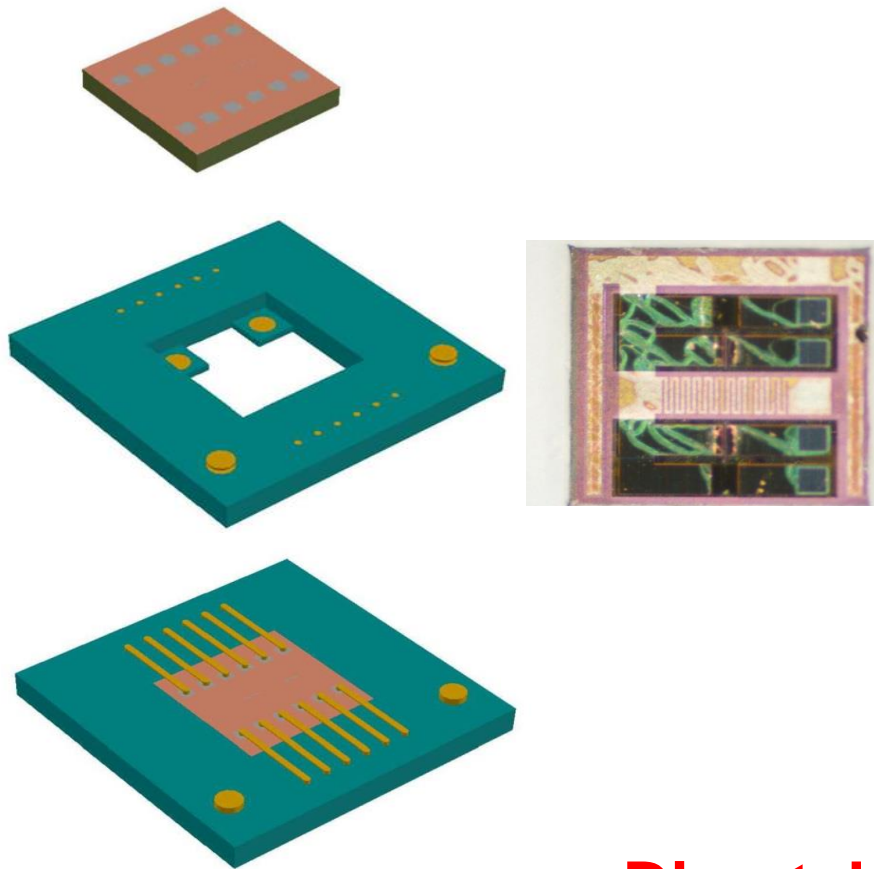
Fly ash with ammonia 84 mg/kg heated to 430 °C /860 °C
Mass spectra and response from SiC-FET sensor

Nanoparticle detector LTCC platform

Functional packaging

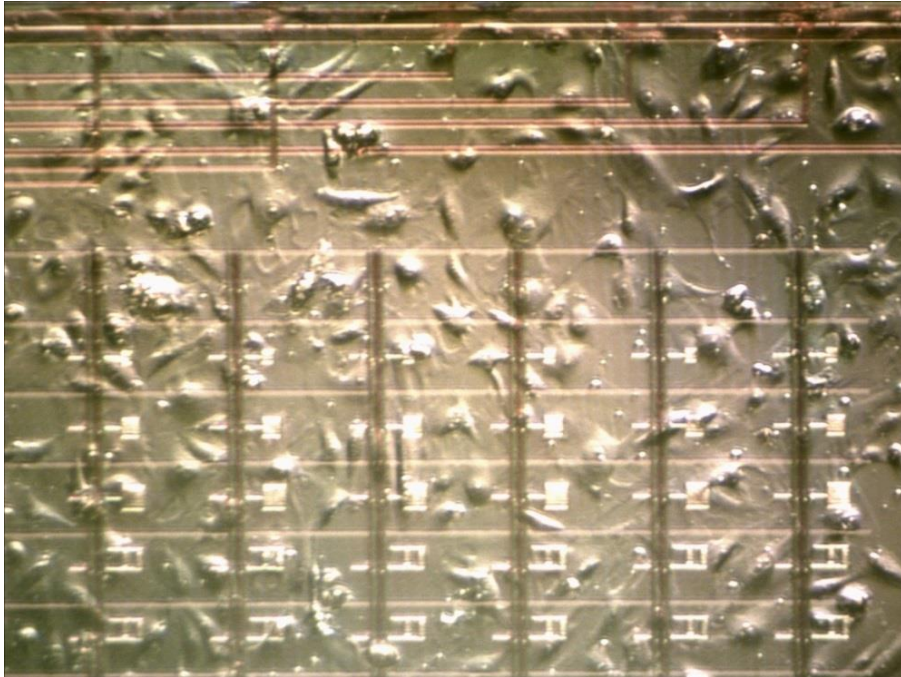


Characterization of particle content

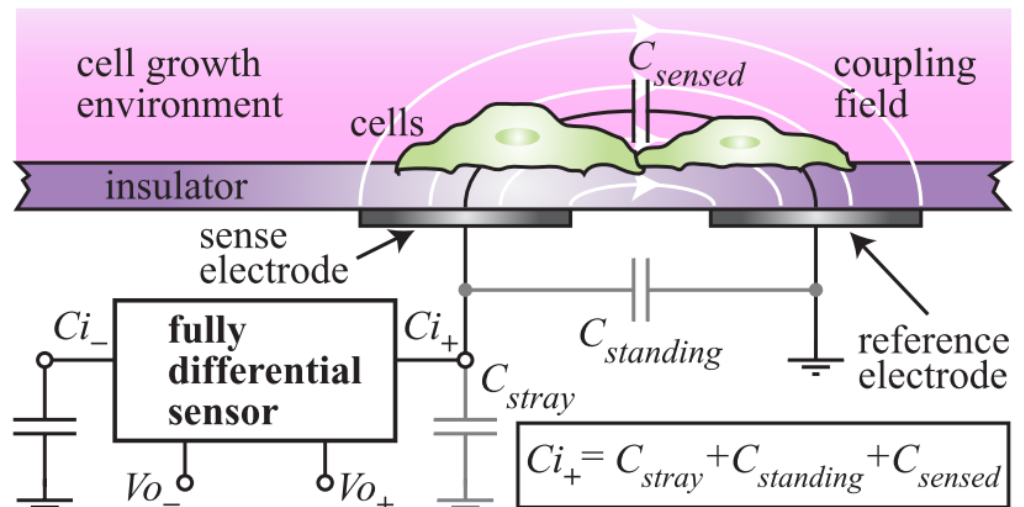


Direct, hermetic sensor integration

Cell Clinic: Measurement of Toxic effect of particles



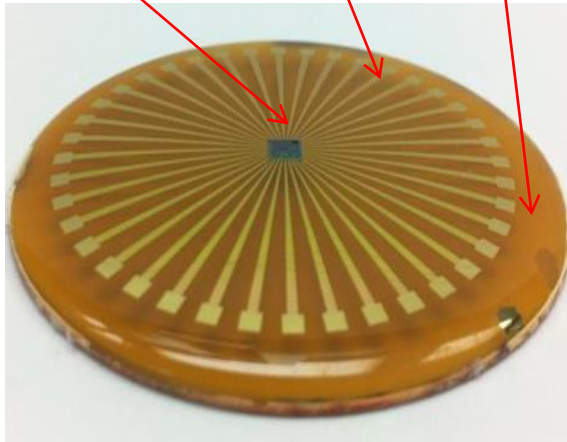
CMOS sensorchip with cells
Kidney cells



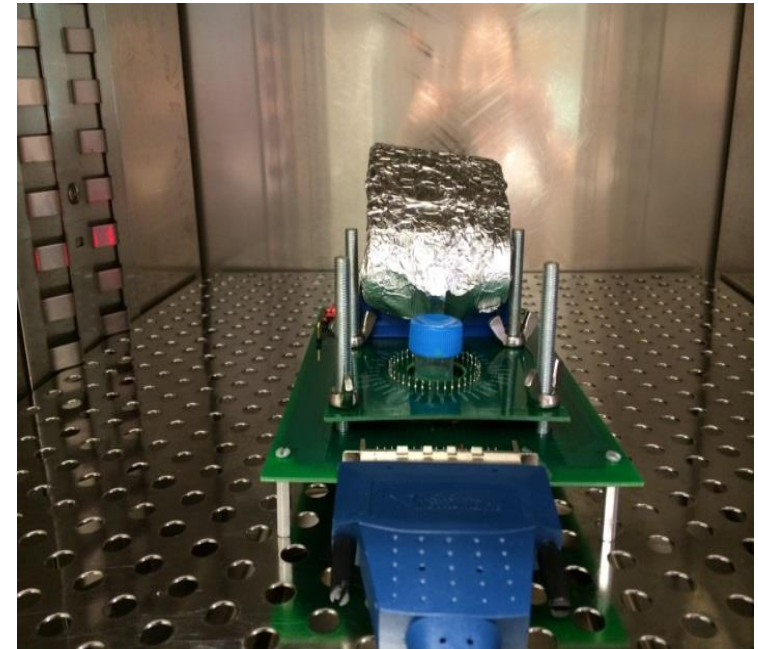
Capacitive measurement principle

Cell Clinic: Measurement of Toxic effect of particles

Sensor chip, Cu leads, epoxy

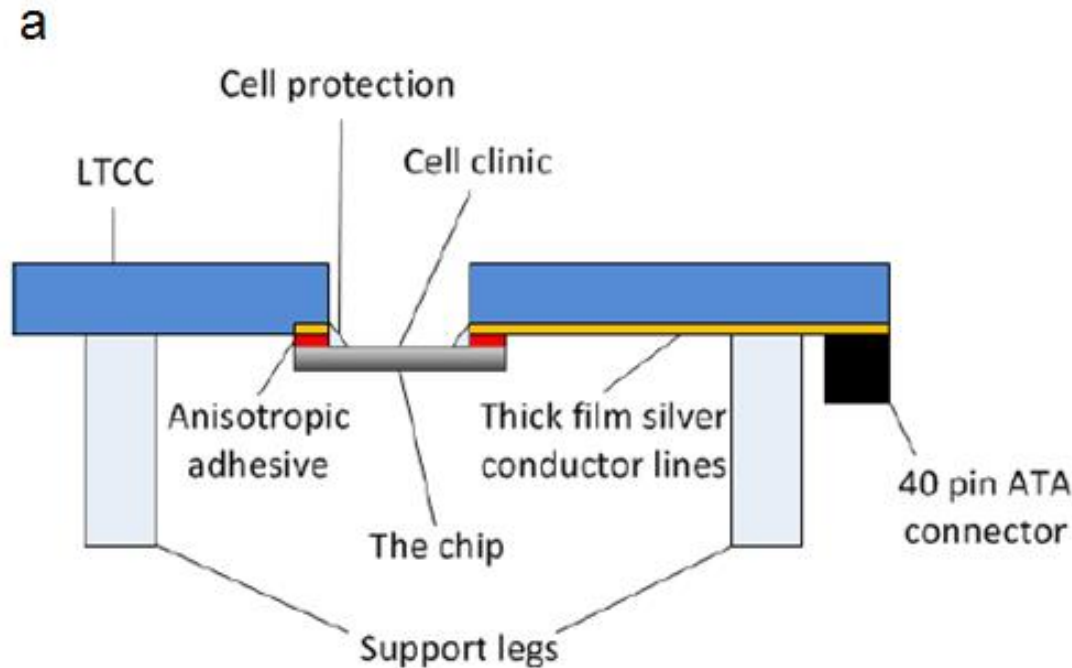


Packaged chip by epoxy molding



Packaged chip with electronics in incubator

Development of microincubator



LTCC packaging of sensor chip

LTCC packaged chip with electronics in the incubator

Development of microincubator for certifying inertness of nanomaterials



Conclusions

- The **content of nanoparticles** is important to measure. Our present approach is based on **LTCC technology housing** with integrated devices and measurement capability like **impedance spectroscopy** or **heating particles** and subsequent **detection of the emissions**
- A **microincubator** is under development: **electrical monitoring of health status of cells** adherant to a **CMOS chip**, during **nanoparticle exposure**



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