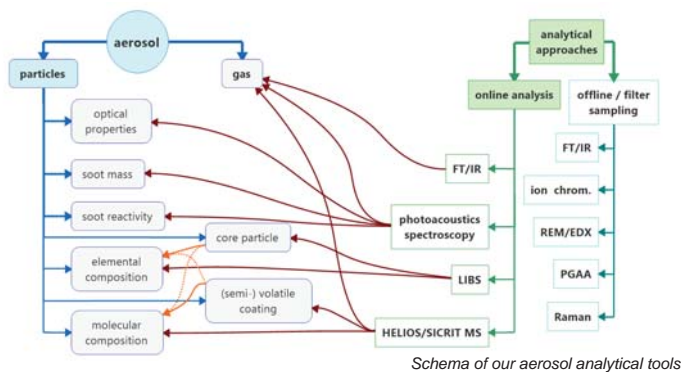


Exhaust Chemical Analysis

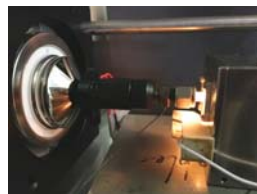
K. M. Thaler, L. Gilardi, E. Ambra, M. Weber, R. Nießner, C. Haisch

Our tools for chemical aerosol analysis



HELIOS/SICRIT-mass spectrometry (MS)

- Measurement of volatile and semi-volatile species
- Special design for desorption of substances from aerosol surface
- Mobil system
- High time resolution

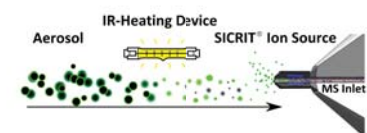


MS inlet with IR heating device

Target:

(Semi-) volatile particles / fractions, delayed primary, secondary particles

Combination of an IR-heating device (HELIOS) and a new ionisation source SICRIT makes the detection of volatile species very easy. Coated particles can be evaporized and measured with high resolution.



Schematic view of the MS setup

Laser-induced breakdown spectroscopy

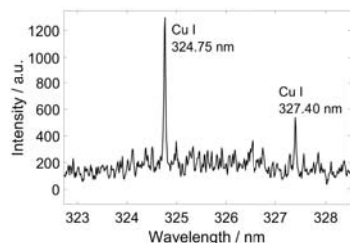
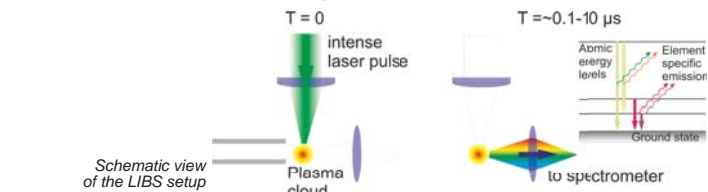
- Elemental aerosol composition
- Measures particles down to 40 nm
- Portable

Target: Solid (core) particles



Laser-induced spark

A pulsed laser is focused on target particles, generating a plasma. Excited elements in the plasma emit light at characteristic frequencies, which can be detected by a spectrometer.

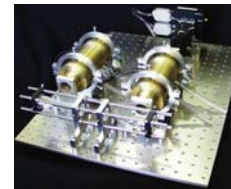


LIBS measurement of 40 nm copper particles.

Plasma emission spectrum

Photoacoustic spectroscopy (PAS)

- Aerosol mass determination
- Low detection limit: 40 ng/m³
- Parallel analysis of gases e.g. N₂O, NO₂, and formaldehyd, possible



Photoacoustic test setup

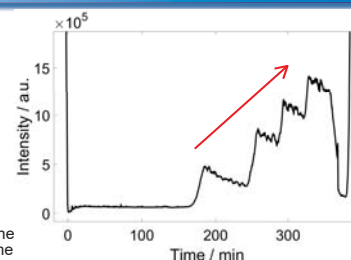
Target:

Soot mass, optical properties of aerosols, gas composition

Some results: organic coatings on soot

MS measurements of anthracene particles of 50 nm size show increasing signal for higher particle concentration.

In cooperation with J. Keskinen, Tampere University of Technology, Finland.

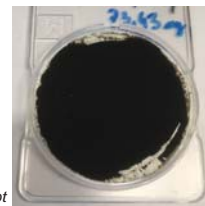


MS signal of anthracene (m/z 179) over time

Offline analysis

Prompt gamma-ray activation analysis (PGAA)

- Elemental sample composition
- Absolute method
- No sample preparation
- Non destructive



Filter covered with soot

Ion chromatography (IC)

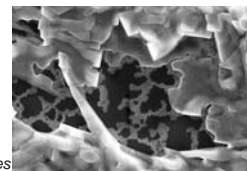
- Analysis of SO₄²⁻ and NO₃⁻
- Standardized according to VDI 3497
- Detection limit: 0.15 µg/filter



Ion chromatography system

Scanning electron microscopy (SEM/EDX)

- High resolution images
- Combination with energy dispersive x-ray spectroscopy possible
- Elemental composition



SEM image of nanoparticles

FT/IR and Raman spectroscopy

- Temperature programmed oxidation (TPO) for soot reactivity
- CO and CO₂ quantification

Summary & Acknowledgement

Complete analytical equipment for the analysis of organic and inorganic matter, core particles and coatings, primary, delayed, and secondary particles.

Development of new analytical tools for dedicated field applications.

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