Name of research institute or organization:

University of Giessen, Analytical Chemistry

Title of project:

Investigation of single particles and ice nuclei for aerosol research at Jungfraujoch

Project leader and team:

Dr. Klaus-Peter Hinz, project leader
Dr. Alois Fendt

Project description:

Single particle analysis by online mass spectrometry has been widely used for the investigation of aerosols in many research fields, such as atmospheric science, homeland security or workplace control. The method provides for a fast chemical and physical in situ characterization of individual particles combined with a high level of specificity.

Mobile instruments of this type can be operated directly at sites of interest for the characterization of aerosols. Such instruments (e.g. LAMPAS 3) use an impact-free particle inlet system for direct introduction of particles into the mass spectrometer. After particle detection and sizing, a pulsed UV-laser is actively triggered to ionize the detected particles, followed by bipolar time-of-flight mass spectrometry [1].

Miniaturization makes such instrumentation accessible for various application fields [2]. In atmospheric science the direct observation of aerosol particles at various sites is important for a better understanding of atmospheric processes. During the measuring campaign CLACE 2013 and INUIT at the Jungfraujoch research station the mass spectrometer LAMPAS 3 was operated for the chemical characterization of micron and super-micron particles. The aim of these investigations was, among others, the characterization of ice nuclei and of background aerosol in the lower troposphere for a better understanding of cloud formation and its influence on earth climate.

A first evaluation of detected outdoor particles showed characteristic signal patterns of mineral and carbonaceous particles as well as mixtures of these particle types with secondary components such as ammonium, nitrate and sulphate in the mass spectra. Statistical evaluation of the mass spectra showed that four main particle types can be chemically differentiated. The comparison of indoor and outdoor particle populations shows similarities of chemical particle composition and abundances of particle types but in outdoor particle spectra the signal intensities of secondary components (ammonium, nitrate, sulphate) are higher. The size of the detected particles was in the range between 0.6 µm and 4.0 µm. This complements the measured size range of other instrumentation during the campaign. In the future, the data will be further evaluated and compared with data of the other participating groups of the network and will lead to an improved description of the Jungfraujoch aerosol.

[1] Hinz, K.-P., Kaufmann, R., Spengler, B., Aerosol Sci. Technol., **24** (1996), 233-242.
[2] Hinz, K.-P., Gelhausen, E., Schäfer, K.-C., Takats, Z., Spengler, B., Anal. Bioanal. Chem., **401** (2011), 3165–3172.

Key words:

Aerosol mass spectrometry, atmospheric aerosols at Jungfraujoch, chemical composition, single particle analysis

Collaborating partners/networks:

Max Planck Institute for Chemistry, Mainz, Germany,
Paul Scherrer Institute, Villigen, Switzerland
and the participating institutions of the INUIT and CLACE 2013 campaign

Scientific publications and public outreach 2013:

Conference papers

Hinz, K.-P., A. Fendt and B. Spengler, Instrumental optimization of the compact laser mass spectrometer LAMPAS 3 for on-line single particle analysis under various field conditions, European Aerosol Conference 2013, Prague, Czech Republic, September 01-06, 2013.

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