

Elemental speciation

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This issue of *Analytical and Bioanalytical Chemistry* contains selected research contributions from the last period of a PhD graduate school on ‘Trace Analysis of Elemental Species: Development of Methods and Applications’, which was established at Johannes Gutenberg University Mainz in Germany. This graduate school was continuously supported for nine years by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) from October 2002 until September 2011, and research groups from different disciplines (analytical, atmospheric and nuclear chemistry; biology; geosciences; medicine and physics) at the University of Mainz participated. In addition, there was much cooperation with groups outside Mainz, for example with those from the University of Münster and the University of Aberdeen, which both also contributed to this special issue. It was the first time that the German Research Foundation had supported a graduate school focused on analytical chemistry.

Speciation is a modern and current analytical discipline where many questions have to be answered especially in environmental chemistry and the life sciences. Many analytical techniques have therefore been developed and corresponding applications have been applied during the last 20 years to environmental and biological samples, especially to ‘traditional’ elemental species such as methylmercury, different selenium and arsenic species and also heavy metals bound by biomolecules. Corresponding topics

have also been investigated over the whole period of this project. However, two fields in which only minor attention was focused in the past, owing to a lack of common knowledge of this topic, were also intensively investigated: elemental species in the atmosphere and those of important radionuclides. In both fields, knowledge of the distribution of an element among individual chemical species is not only important to obtain the fundamental physicochemical properties of the constituents, i.e. their vapour pressure, hygroscopicity or solubility, this information can also be used to reliably predict and understand sources, transformation and environmental effects of the compounds of interest. In addition, also topics only recently involved in elemental speciation such as the determination of isotope variations in elemental species and the investigation of nanoparticles were highlighted.

Many new analytical methods have been developed to allow selective and sensitive elemental speciation. For example, corresponding techniques for ultratrace determinations of radionuclides were developed by resonance ionization mass spectrometry, and two of the last corresponding developments by the group of Klaus Wendt (Physics Department) are published in this issue. Online coupling of gel electrophoresis and inductively coupled plasma mass spectrometry was developed by Wolfram Brüchert in the group of Jörg Bettmer (Institute of Inorganic and Analytical Chemistry) and a novel ion trap mass spectrometer for atmospheric aerosol particles was constructed by Andreas Kürten in the group of Stephan Borrmann (Institute of Atmospheric Physics). For these developments the last two PhD students mentioned received the prominent ‘Wolfgang Paul Award’ of the German Society for Mass Spectrometry. A trend article on the present status and on future trends of speciation by online aerosol mass spectrometry is also published in this issue. Altogether, more than 100 articles, often with an analytical focus, have been published in connection

Published in the topical collection *Modern Aspects on Elemental Speciation* with guest editors Thorsten Hoffmann and Klaus G. Heumann.

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with the graduate school in peer-reviewed journals from the participating groups up to now. A list of publications can be found at http://www.gk-spurenanalytik.uni-mainz.de/177_ENG_HTML.php.

The guest editors of this collection of articles, Thorsten Hoffmann and Klaus Heumann, were chairmen of this graduate school, Klaus Heumann at the beginning from 2002 to 2005 and Thorsten Hoffmann from 2005 until 2012. We think that this graduate school not only allowed many students to be introduced to a fascinating research area (http://www.gk-spurenanalytik.uni-mainz.de/174_ENG_HTML.php), but also contributed substantially to this important and current discipline of analytical chemistry. One of the most remarkable characteristics of the graduate school was the typically straightforward transition of those who completed PhD degrees into professional scientific life, even when the PhD degree was done in geography or biology, fields where appropriate positions are more difficult to find than, for example, in chemistry. However, this clearly demonstrates that analytical chemistry as a real cross-sectional discipline with a strong applied character is ideally suited for the qualification of doctoral researchers in the framework of an interdisciplinary research programme. We thank all authors who contributed to the speciation part of this issue and we hope that the many other PhD students and research groups involved during these 9 years of the graduate school will profit in the future from this interdisciplinary research in analytical chemistry.

Thorsten Hoffmann has been Professor of Analytical Chemistry at Johannes Gutenberg University Mainz since 2003. Before he held a stand-in professorship at the University of Leipzig and was coordinator of the research areas ‘Analytical Methods in the Life Sciences’ and ‘Atmospheric Trace Constituents’ at the Leibniz-Institut für Analytische Wissenschaften – ISAS in Dortmund. His main research activities are the design and development of tailored methods focussing on the chemical characterization of biologically and environmentally relevant matrices. The results are aimed at understanding the interactions between the biosphere and the atmosphere, such as formation and characterization of aerosols from natural or anthropogenic sources and the development of trace analytical techniques to investigate climate archives. Most of the analytical research is focussed on organic analytes in combination with mass spectrometry (gas chromatography/mass spectrometry, liquid chromatography/mass spectrometry) with a certain emphasis on the development of real-time methods for aerosol characterization (aerosol mass spectrometry).

Klaus Gustav Heumann is Emeritus Professor of Analytical Chemistry at Johannes Gutenberg University Mainz. His research interests lie in the development and application of analytical methods for the determination of trace elements and trace amounts of elemental species, using inductively coupled plasma mass spectrometry, thermal ionization mass spectrometry, different types of optical atomic spectrometry and electroanalysis as detection methods, and high-performance liquid chromatography, capillary electrophoresis and capillary gas chromatography as separation methods. He has received several awards, including the Clemens Winkler Medal of the German Society for Analytical Chemistry in 2004 for his scientific lifework and for continuous support of analytical chemistry in Germany. In 2007 he received the European Award for Plasma Spectrochemistry. He is a member of several national and international scientific societies, and he was a member of the IUPAC Commission on Atomic Weights and Isotopic Abundances for 12 years and was chairman from 1991 to 1995.



Thorsten Hoffmann (*left*) and Klaus Heumann relax after a seminar by graduated PhD students.