Comment

Combinatorial explosion in separation sciences

New approaches for high quality information

Prof. Dr. Gérard Hopfgartner
Life Sciences Mass Spectrometry, Sciences Faculty, University of Geneva, Switzerland

In analytical sciences one of the major goals is to develop and validate methods for the identification and quantification of molecules in complex samples to support investigations in the pharmaceutical sciences, environmental sciences, food sciences, biology and medicine.

A typical workflow consists in isolating the analyte from the matrix, separating it from other similar constituents and selectively identifying them. One of the key separation techniques is chromatography, which was pioneered by Mikhail S. Tsvet in 1900. Tsvet separated compounds of leaf pigments, extracted from plants using a solvent, in a column packed with particles. Over the years the technique has evolved by working with higher pressures, and has given rise to the acronym HPLC, standing for high pressure liquid chromatography, which is now one of the major techniques in the separation sciences. Today operating pressures in the range of 600 to 1,600 bar are routine. Using smaller particle geometry, resulting in improved separation resolution, various particle chemistries have been developed, making it possible to use different separation mechanisms to cope with the analysis of both small molecules and macromolecules. On-line light scattering, ultraviolet and fluorescence spectroscopy are the most commonly used detection methods. The development of atmospheric pressure ionization techniques (in particular, electrospray ionization) has given rise to the coupling of ultra-pressure liquid chromatography and mass spectrometry. This combination has raised standards in separation power and detection, opening new avenues in the multi-components analysis that is mandatory for proteomic and metabolomic investigations. In addition, the integration of real time multi-dimensional liquid chromatography, ion mobility spectrometry and tandem mass spectrometry adds several dimensions in sample analysis. Ideally, one would like to gather as much information as possible from a single analysis, and a coupling or combination of techniques is highly desirable to cope with these challenges, resulting in a combinatorial explosion of possible approaches. While high quality information is required to push limits in the sciences, the development of high sample throughput and miniaturization approaches in various areas will be needed in order to take full advantage of these new analytical tools. Many of these topics, including fundamental aspects of separation sciences and combinations

Gérard Hopfgartner, studied chemistry at the University of Geneva and received his Ph.D. degree in 1991 in the field of organic geochemistry and mass spectrometry. He pursued his formation as a postdoctoral fellow at Cornell University in the domain of LC-MS/MS atmospheric pressure ionization. Then in 1992 he joined the DMPK Department of F. Hoffmann-La Roche in Basel where he was in charge of the bioanalytical section. Since April 2002 he has been full Professor for analytical sciences and mass spectrometry at the University of Geneva. His scientific interests include the application and the development of novel mass spectrometry approaches with and without chromatography in the field of life sciences in particular, metabolomics, analytical proteomics, Qual-Quant bioanalysis and toxicology.

involving mass spectrometry and high-end applications, will be discussed between academic, industrial, young and established scientists from all over the world at the 42nd International Symposium on High Performance Liquid Phase Separations and Related Techniques, to be held from 21 to 25 June at the International Conference Center (CICG) in Geneva, Switzerland.

■ **gerard.hopfgartner@unige.ch**