Analytical and bioanalytical luminescence

Petr Solich

Published online: 25 February 2011
© Springer-Verlag 2011

Analytical and bioanalytical luminescence-based techniques—from photoluminescence to bioluminescence and chemiluminescence, regarding both basic science and applications in biomedical, pharmaceutical, environmental, and food analysis—have an important position in research and modern technology. High sensitivity is common to practically all luminescence methods and it is not extraordinary to have limit of detection (LOD) even at subpicomolar levels. In addition, the log–log intensity versus concentration calibration plots can be linear over several orders of magnitude of concentration. It is evident that the high detectability and rapidity of luminescence detection make it suitable for the development of microarray-based high-throughput screening assays, in which simultaneous, multi-analyte detection is performed on multiple samples.

So far luminescence detection has been exploited in flow-injection analysis and column liquid chromatographic and capillary electrophoretic separation because of its high sensitivity compared to spectrophotometric detection. Recently, miniaturisation induced a revolution in analytical chemistry analogous to that which occurred in electronics

earlier but with a less dramatic impact. The benefits of miniaturisation are easy to see:

1. reduced sample volume;
2. reduced reagent cost;
3. faster analysis;
4. parallelisation, integration, and automation becomes possible; and
5. portable instruments can be constructed.

Applications involving lab-on-chip (μ TAS, micro total-analysis system) coupled with luminescence detection will surely be of utmost importance in many areas of analytical and bioanalytical chemistry. The areas of environmental analysis need portable low-cost analysers and the new emerging technologies based on luminescence phenomena seem to make the construction of these devices both technically and economically easier and easier. Nano- and microfabrication play an ever increasing role in science and technology and will soon enable scientists to build systems of the same complexity as found in nature. Conventional methods that emerged from microelectronics are now used for the fabrication of structures for microelectromechanical systems, micro-optics, and microanalytical devices.

Luminescence is also frequently used for the sensitive and specific location and quantification of target analytes in tissue sections and single cells by immunohistochemistry and in situ hybridization techniques. Enzyme activity and enzyme substrates and inhibitors can be efficiently determined when directly involved in luminescent reactions, and when they take part in a reaction

Published in the special issue *Analytical and Bioanalytical Luminescence* with Guest Editor Petr Solich

P. Solich (✉)
Department of Analytical Chemistry, Faculty of Pharmacy,
Charles University,
50005 Hradec Králové, Czech Republic
e-mail: petr.solich@faf.cuni.cz

suitable for coupling to a final light-emitting reaction. The strength of chemiluminescence and electrochemiluminescence methods is a low-cost excitation step, because there is no need for expensive lasers or accurate excitation optics. However, solid-state lasers are continually becoming better and less expensive, and the price of the instrument is typically not the most important issue.

It can be concluded that analytical and bioanalytical luminescence are versatile, ultrasensitive tools with a wide range of applications in diverse fields, for example clinical and environmental chemistry, biotechnology, pharmacology, molecular biology, and related sciences. Last but not least, articles presented in this special issue confirm that luminescence methods seem to have very bright lights ahead, although very low light levels are being detected.

Petr Solich

is currently Professor and Head of the Analytical Chemistry Department at the Faculty of Pharmacy, Charles University in Hradec Kralové, Czech Republic. His research interests are automation of analytical procedures, flow methods (flow-injection analysis, sequential injection analysis, and sequential injection chromatography), chromatographic methods (mainly UHPLC with sub-2-micron columns or use of monolithic columns)

applied to environmental analysis of low concentrations of pharmaceuticals or bioanalytical analysis for determination of biomarkers, and, finally, modern sample-preparation methods used in environmental and bioanalytical applications. He has published more than 140 research papers and has been responsible for more than 20 research grants from different disciplines (pharmaceutical, environmental, health care).