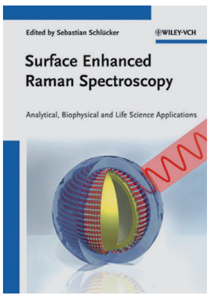

Surface Enhanced Raman Spectroscopy
Analytical, Biophysical and Life Science Applications. Edited by Sebastian Schlücker. Wiley-VCH, Weinheim 2010. 332 pp., hardcover, € 119.00.—ISBN 978-3527325672

Surface Enhanced Raman Spectroscopy

This Wiley-VCH collection of articles on surface-enhanced Raman spectroscopy (SERS), edited by Sebastian Schlücker, focuses on the technique's applications to the analysis of diverse biological and (bio)medical samples, ranging from membrane models and tagged phospholipids to DNA, cells, cytochrome c, organic pollutants, and pharmaceuticals.

It describes the rapid, reproducible, and highly sensitive detection of and discrimination between different biochemical species by using SERS, partly in combination with other methods such as chromatography, microfluidics, and electrochemistry. It is a challenging task to capture in a book the state of the art in such a rapidly evolving field as SERS. In this collection the bibliographies covering the literature up to 2009 provide a good starting point, but that may be outdated rather soon if the current pace of development continues.

Chapter 1 gives an introduction to the principles of the interaction between light and matter on the nanoscale, which provides the theoretical background to the SERS effect. That is followed in Chapter 2 by an extensive collection of methods for preparing substrates for SERS. The crucial, and by no means trivial, question of how to reliably obtain SERS data that can be analyzed quantitatively is addressed in Chapter 3. Common pitfalls and advantages or disadvantages of various substrates, also in competition with standard analytical methods, are described and critically evaluated. Chapter 4 contains a sound and thorough discussion about the possibilities and limitations of single-molecule or trace detection with SERS.

Chapters 5 and 6 review the applications of SERS to the detection of pollutants and pharmaceuticals, respectively. An increasing number of different molecular species can be detected, thanks to the development of surface-modifying linkers. Nevertheless, in my opinion, to achieve straightforward identification of individual compounds with a large number of Raman bands is a challenging goal.

The advantages of combining SERS with other analytical techniques such as chromatography, microfluidics, and electrochemistry are discussed in Chapters 7 to 10. While these describe exciting examples that show how separation science with subsequent characterization by SERS has progressed from fundamental research to real-life applications, it seems that the very promising concept of miniaturized SERS-on-a-chip devices has yet to attract widespread interest in potential target areas such as biomedical diagnostics or clinical chemistry. Similarly, electrochemical SERS studies envision the potential offered by this synergy of methods, particularly for the study of complex biological systems where both mass transfer and electron transfer play important roles, e.g., for determining elementary reaction steps in biological processes that are inaccessible with other techniques.

In Chapters 11 to 13, applications of SERS labels for quantitative DNA analysis, immunohistochemistry, and detection of intracellular compounds are presented. Sacrificing the advantage of label-free characterization inherent in "normal" SERS is compensated for by the advantages of direct quantification, high sensitivity, and the availability of an (in principle) infinitely large number of possible Raman reporter molecules that greatly facilitates simultaneous multiplexing, compared to the fluorescence tagging methods that are routinely employed.

Chapter 14 concludes with a brief description of sophisticated sister techniques of SERS: nonlinear surface-enhanced coherent anti-Stokes Raman scattering, which gives increased sensitivity, and tip-enhanced Raman spectroscopy, which provides spatial resolution in the order of 20 nm, and a combination of these two.

While style and emphasis vary between the individual authors, the order of the chapters appears to have been very well thought out, continuously increasing the knowledge base from basic SERS principles and applications to combinations with other methods, then to more complex analytical systems, which results in pleasant cover-to-cover reading. At the same time, the various contributions from different authors also function as stand-alone reviews, which allows selective reading according to personal interest. Written and edited by renowned SERS researchers, the book emphasizes the methodology and its advances towards applications, which makes it interesting for scientists working in spectroscopy and surface sciences. In my opinion, an additional concise description of the capabilities of standard analytical methods in life sciences—with which SERS has to compete in terms of sensitivity, applicability to existing laboratory analysis protocols, and price—would have benefited the volume and made it more attractive for potential readers (and SERS users) from life sciences.

Finally, nearly all contributors conclude that, although SERS has matured considerably, it is still some way from being employed as a routine diagnostic tool in (bio)medical research, but holds great promise to achieve that. I completely agree.

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