
Preface

In the booming fields of the life and material sciences, advances are taking place on all fronts and often involve the use of luminescence techniques as analytical tools and detection methods due to their high sensitivity, intrinsic selectivity, noninvasive (or at least minimally invasive) character, comparative ease of use, potential for multiplexing applications, and remote accessibility of signals. Despite the fact that the measurement of fluorescence—with its birth marked by the study of Sir Stokes on quinine sulfate in 1852—is not a new technique and many fluorescence techniques have matured to a state where quantification is desired, standardization of the broad variety of fluorescence methods and applications is still in its infancy as compared to other prominent (bio)analytical methods.

It is still often overlooked that all types of fluorescence measurements yield signals containing both analyte-specific and instrument-specific contributions. Furthermore, the absorption and fluorescence of most fluorophores is sensitive to their microenvironment, and this can hamper quantification based on measurements of relative fluorescence intensities as well as accurate measurements of absolute fluorescence intensities. Hence, the realization of a truly quantitative measurement is inherently challenging. This situation renders quality assurance in fluorometry very important, especially with respect to the increasing complexity of instrumentation, and the blackbox-type of present-day instruments and software. This may compromise future applications of fluorescence techniques in strongly regulated areas like medical diagnostics and clinical chemistry that are within reach.

As a result, there is an ever increasing need for (a) recommendations and guidelines for the characterization and performance validation of fluorescence instrumentation and the performance of typical fluorescence measurements, and (b) for an improved understanding of fluorescence-inherent sources of error. This is closely linked to the availability of suitable and easily handled standards that can be operated under routine analytical conditions, are adequately characterized, and meet overall accepted quality criteria.

Within this context, the aim of this book is to provide a unique overview on the current state of instrumentation and application of a very broad variety of fluorescence techniques employed in the material and especially in the life sciences thereby highlighting the present state of quality assurance and the need

for future standards. Methods included span microfluorometric techniques used for immunoassays, fluorescence microscopic and imaging techniques including single molecule spectroscopy, flow cytometry and fluorescence in situ hybridization to the microarray technology and technologies used in biomedical diagnostics like in vivo fluorescence imaging. Method-inherent advantages, limitations, and sources of uncertainties are addressed, often within the context of typical and upcoming applications. The ultimate goal is to make users of fluorescence techniques more aware of necessary steps to improve the overall reliability and comparability of fluorescence data to encourage the further broadening of fluorescence applications.

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