

Preface

Bioaerosols, in the context of this book, are defined as airborne dispersions of particles containing whole or parts of biological entities and debris, such as bacteria, viruses, dust mites, biological toxins, or fungal components. Bioaerosols travel in the atmosphere and may have an important impact on both environmental processes and human health. In some cases, there is a desire to follow the concentration of a certain biological substance in the air. One noticeable example is from the military and anti-terrorist arena, where different ways to warn people about exposure to deliberately disseminated dangerous biological substances is critical. Apart from military or terrorist threats, monitoring of other bioaerosols that may have an impact on our health and environment is of great interest. During the last decades we have seen examples of disease spreading events in the society, e.g., the foot and mouth disease outbreak in the UK in 2001, the SARS outbreak in 2002–2003, and H1N1 (swine flu) in 2009. Preventive actions, such as exposure reduction and medical treatment are generally more effective the quicker they are initiated. Therefore, the impact of these incidences could be reduced with better and more rapid methods of bioaerosol monitoring. Finally, a direct way of monitoring the real-time biological fluctuations in the atmosphere can assist in understanding fundamental aspects in the indoor or outdoor environment.

Over the years there has therefore been an increasing interest in developing specific technologies and methods that can detect and characterize the population of the bioaerosols. An ideal bioaerosol detection system should be able to monitor, in real-time, the actual concentration, down to single organism level, and recognize it with very high specificity. Presently, no single sensor or detection technology reaches these requirements.

Traditional molecular biotechnological methods, such as genetic and/or immunological technologies, can provide the high specificity, but the response times reach from many minutes to hours and even days since they may need sample preparation and wet chemistry or culturing. To reach high sensitivity these methods may also need purification and amplification steps, e.g., polymer chain reaction (PCR), which also takes time.

Detectors based on physical phenomena such as elastic and inelastic scattering, laser-induced fluorescence, emission and mass spectroscopy can give information

about size, shape and molecular or elemental composition of the aerosol particles. This information can be used, to a certain degree, to determine biological properties of an aerosol particle. These direct detection technologies can both be sensitive and, more importantly, provide very fast response times.

Biotechnological methods are well covered in the literature as well as traditional methods for sampling and analyzing bioaerosols. However, very few books give an overview of the different rapid detection technologies allowing near real-time detection and monitoring of bioaerosols, especially for wide area surveillance.

This book is intended to give technological background and practical examples, but also to give general insight into the on-going technology development in the area of biodetection. The content is therefore suitable for different stakeholders (decision makers, purchasing officers, etc.) and end-users of biodetection equipment within the areas of health, environment, safety and security, and military preparation. In the end, we hope that the reader of this book will gain more knowledge about the different biodetection technologies and thus better judge their capabilities in relation to desired applications.

The first section of the book is an introduction to the whole area of bioaerosol detection and monitoring. It includes the fundamental physical and biological properties of bioaerosols, how bioaerosols are dispersed and transported in the atmosphere and how the aerosols can be sampled and transferred into detection systems. Also covered is the terminology used in this research area, as well as a historical survey of the early attempts to construct bioaerosol detectors which led to the first fluorescence-based detector.

The second section of the book contains more detailed information about the most commonly used detection principles for continuously monitoring bioaerosol content. The section thoroughly describes the basic principles of elastic and inelastic light scattering, absorption, laser-induced fluorescence, atomic emission, and mass spectroscopy. The basic principles are described, and practical examples are given, as well as discussions about their potential use as biodetectors.

The third section is especially devoted to technologies that have been used in standoff applications. After a short introduction, the section is focused on fluorescence-based techniques and a technique based on multiple light scattering in an aerosol cloud.

The last section of the book gives an overview of trends in bioaerosol detection both with respect to challenges, technologies and applications.

The chapter authors in the book have provided their material and it has been processed by the book editors. The views stated do not necessarily reflect the official position of the organizations to which the authors belong.

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