

Preface

We believe that the development of luminescent sensors will have a strong social and economical impact. As scientists actively working in this field since many years, we would like to start by thanking Prof. Vincenzo Balzani, who as a previous member of the editorial board of *Topics in Current Chemistry* was the one who proposed a volume on this subject.

In this volume, through a short but multisided overview, we try to provide the reader with an understanding of how deeply the merging of the three main scientific areas *sensing*, *luminescence* and *nanotechnology* can impact on our everyday life. In this preface, we will give a short introduction to the general fundamental principles of each, hoping that this will allow an easier and clearer understanding of the “result of their sum”.

We can say, from a very broad and generalized point of view, that sensing processes necessarily entail the exploitation of one or more chemical–physical phenomena to convey information about the external environment (the sensing domain). What follows this is the conversion of the stimulus of the sensed phenomenon/species into a signal or data stream that can be understood and manipulated.

In particular, *chemical sensing* involves the design of single molecules or of arrays of molecules that specifically recognize a chemical species in a reversible manner and in a given concentration range. The need for reversibility is an essential requirement for continuous or *in vivo* monitoring, but in the case of once-off measurements it is not always necessary. Moreover, in recent times, single analyte sensing has been flanked by new kinds of systems that are able to detect classes or mixtures of chemicals in a similar manner to which nature has developed human taste or smell.

As these requirements are rather complex, the advent of *luminescent signalling* systems and luminescent-based devices continues to bring about many advantages, since fluorescence measurements are usually very sensitive, low cost, easily performed and versatile, offering submicron visualisation and submillisecond temporal resolution. Consequently, luminescent chemical sensors play a major role in key fields such as industry, diagnostic and therapeutic medicine, and various kinds of environmental monitoring.

Likewise, since *molecular nanotechnology* is the most advanced frontier of research in many scientific areas, it is again not surprising how this is also the framework of the natural evolution and development of sensors. Nanotechnology is certainly still a science in its infancy, but it is already extensively affecting our daily lives with many different products that span the widest variety of applications. There are valid safety concerns about the production and use of nanomaterials, and increasingly research is still needed to separate speculative risks from real ones. This is particularly true for *nanoparticles*. In fact, nanoparticles, among all the nanostructured materials, not only have the highest number of industrial applications, but they are also the most extensively studied worldwide. These extremely versatile nanoobjects are usually described as small spheres with controlled dimensions and a radius in the range of nanometers, but their shape can vary significantly, as can their constituting material (metals, semiconductors, lipids, polymers, etc.), and their surface derivatization with different capping agents (receptors, reactive sites, electroactive or photoactive functionalities, DNA strains, etc.).

Merging nanotechnology and luminescent signalling can therefore lead to the creation of unique materials that can induce great improvements in the technical development of many areas. In this volume, leading scientists present comprehensive reviews on modern research trends that accompany the reader on a journey from optical and luminescent chemosensors and biosensors (cite the contributions of Prof. A.P. de Silva and Prof. O. Wolfbeis), also exploiting chiral sensing (Prof. Corradini), to their implementation in more complex structures to yield materials able to perform signal amplification (contributions of Prof. Rurack and Prof. Prodi) and to be included in detection devices (contributions of Prof. Rurack, Prof. Prodi, Prof. O. Wolfbeis and Prof. Paolesse).

We believe that the high impact on different fields and the variety of approaches to the topic will attract the attention of scientists from different communities such as chemistry, materials, technology, medicine and industry. We also hope that the writing style will enable readers from diverse areas of research to fully enjoy the presentations on this fascinating subject, and we hope to offer at least a taste of its huge potential.

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