

Preface

Over the years, the number of academic publications on the development of chemical sensors has increased dramatically from 76 articles in 1983 to 7461 articles in 2015 (according to a Scopus Web search using the phrase “chemical sensor”). Additionally, the commercial market is increasing its search for new chemical sensors in order to monitor a plethora of analytes in real time and in an efficient and cost-effective way. Areas of application include environmental monitoring, food science and safety, and wearable technologies for point-of-care devices tracking medical status. There is an ongoing work in the development and application of cheap, biodegradable materials to monitor diseases in areas with poor infrastructure. The development of new chemical sensors and the improvement of existing ones have become a collaborative endeavor, integrating multiple disciplines, such as chemistry, physics, engineering, biology, materials science, mathematics, and bioinformatics. This book starts with a definition of the chemical sensor in Chap. 1, followed by how this chemical sensor could extract chemical information using optical and electrochemical techniques in Chap. 2.

The combination of chemical sensor with low-cost materials, more specifically paper-based devices, has progressed in the last 10 years and has been stimulating recent research activities in the development of point-of-care device to be used in developing countries. Chapter 3 is dedicated to this type of device with the exploitation of biomaterials, such as enzymes and antibodies, to recognize the chemical information. The key point for the development of a chemical sensor is related to the materials used to recognize and translate the chemical information through a chemical interaction or reaction. However, there is not a quantitative theory or model to be used which describes physical and chemical parameters to obtain improved materials that will recognize the species being analyzed, and the steps to obtain a better material are largely empirical and could be sometimes seen more like an art than a science. However, the use of enzymes to translate the information is common, and researchers are attempting to mimic the enzyme and antibody environments in order to create artificial receptors and other biomimetic compounds, such as molecularly imprinted polymers. In this approach, they are

trying to copy nature in order to achieve the same level of recognition and affinity, and Chap. 4 will discuss this topic.

Chapters 4–8 will show how different natural and synthetic materials influence the development of chemical sensors. Chapter 5 will discuss how classes of carbon, such as graphene and its derivatives, offer different nanofeatures, structures, and dimensions, which provide transduction recognition with potentially novel sensing properties. Chapter 6 will show how nanomaterials could be turned into a personalized monitoring platform in the form of wearable and implantable sensor network systems, which would allow people's activities to be monitored. Chapters 7 and 8 will demonstrate how other synthetic or natural materials, such as self-assembled films and phthalocyanines, can be useful for enhancing sensing performance. Chapter 9 will demonstrate how array-based chemical sensors, combined with chemometric data processing tools, can be used to mimic the human tongue, one of our more sophisticated sensors.

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