PREFACE

Although most of the basic principles of optoelectronic (OE) sensors have been known for more than forty years, and optoelectronic sensor technology emerged over the past 10–20 years, the industrial applications are relatively new. The last years, however, have seen a growing interest in this field, which has resulted in a market growth rate of more than 50% per year. On the other hand, the overall optoelectronic market is quite healthy, nowadays, and is going to be mature as a trillion dollar business.

The reasons for the success of OE sensors may be attributed on one hand to the strong decrease of the price of most of the required devices, also due to the increasing diffusion of low-cost optical telecommunication components, and on the other hand to the possibility of easily integrating many optical devices in a single chip.

The availability of a large variety of new or advanced materials has also contributed to the improvement of the general performance of optoelectronic sensors and of their design flexibility.

Looking at the scientific literature, it clearly appears that in the recent years there has been an increasing number of journals and magazines dealing with the subject of sensors, with large room dedicated to optical and optoelectronic devices. Every year, published papers propose a large number of novel configurations and applications.

In parallel, a growing number of industrial applications is also being demonstrated, which run from a better process control to safety and security improvement, with particular care devoted to transportation, environment, structural health monitoring and food quality. As diagnostic OE devices continue to be kept smaller, more portable, more energy efficient, and cheaper, their use in bio-medical applications will continue to grow. We can also expect that OE sensors will significantly contribute to intelligent information systems in stationary and mobile applications.

The emergence of nanotechnologies is also having an effect on OE sensors, and it is likely that integrated nanoscale sensors will revolutionize health care, climate control, and detection of toxic substances.

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According to Michael Lebby, President and CEO of OIDA, the Optoelectronics Industry Development Association (USA), the potential market for photonics sensors alone for 2009 exceeds 5 billion dollars, with fiber optic sensors taking the lead (Fig. 1).[a]

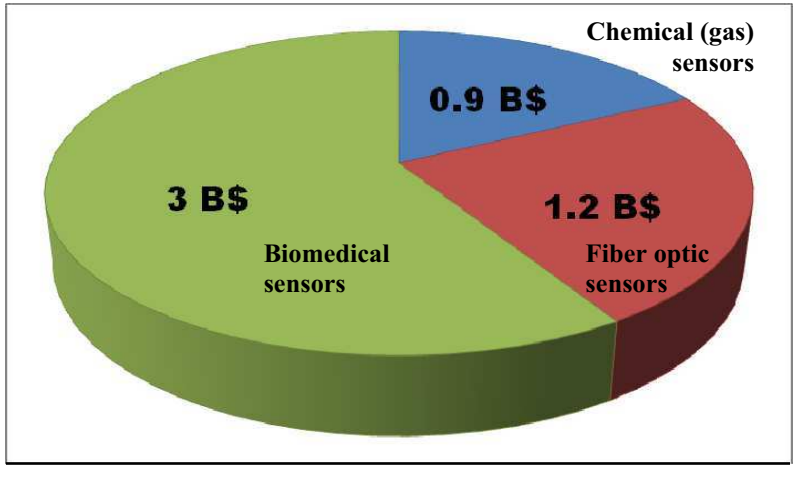

Fig. 1 Photonic Sensor Market Potential in 2009.

Far from being exhaustive, and according to its title, this book aims at providing a basic background in the field of optoelectronic sensors for graduate students or for people approaching this field. We hope, however, that the information provided will be of valuable interest to physicists, engineers, material scientists and systems designer who wish to obtain a broad review on the subject. Additionally, this book provides an excellent overview of the state of the art of the R&D in this field in Italy, boasting contributions from renowned academic and industrial experts.

For their relevance in a great variety of practical applications, particular attention has been paid here to the field of optical fiber sensors (OFS). Taking advantage of the integration with different materials and appropriate micro- and nano-structuring, OFSs have revealed an enormous potential for the design and production of innovative instrumentation.

[a] http://www.optofluidics.caltech.edu/publications/industry.html

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In the first part of the book, attention is paid to the basic principles and technologies of the most relevant OE sensor classes, from the "classical" infrared detectors to the most innovative photonic crystal structures, without neglecting fashion THz sensing technologies. Examples of relevant applications are also provided.

The in-depth analysis of some application areas is the subject of the second part of the book, where OE sensors for structural health monitoring, environmental monitoring, medicine, materials and process control, are described and discussed.

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Giancarlo C. Righini
Antonella Tajani
Antonello Cutolo

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