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Introductory Chapter: Temperature Sensing - The Book

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1. Introduction

Temperature is the most often-measured environmental quantity, and temperature sensors can be found just about everywhere. They are present at our homes, schools, workplaces, cars, busses, airplanes, home appliances, and electrical devices. They are being used in environmental monitoring and various industrial, medical, and biological applications for process monitoring and control. Scientists are continuously improving ways of temperature sensing, and list of temperature sensor applications grows longer every day. Our idea was to invite scientists from different parts of the world to share their knowledge, ideas, and research results in the field of temperature sensing. Thanks to their efforts, readers are given an opportunity to learn more about temperature sensing based on optical fiber sensing technology and tunable diode laser absorption spectroscopy, industrial applications of tunable diode laser absorption spectroscopy, and last but not least about temperature measurements in machining of aluminum alloys.

2. Temperature sensors and applications

Over the past several years, fiber-optic sensing technology gained the potential to replace conventional electromechanical-based temperature sensors that are being used in various environments ranging from normal to harsh and hardly accessible ones. Fiber-optic cable has a number of assets that include resilience to electromagnetic interference, ability to withstand high temperature environments, and sensitivity of light pulses that are being transmitted through the fiber to ambient temperature.

One of the typical structures that are being used in fiber-optic temperature sensing is optical fiber Mach-Zehnder interferometer (MZI). Optical fiber Mach-Zehnder interferometer

sensors have lately attracted the great attention because of their structural properties, simple fabrication process, and low cost. They have been used in various physical and chemical sensing applications including temperature sensing. The first chapter gives us a detailed overview of the theory of the traditional separated MZI structures along with the theory of the optical fiber inline MZI that is lately often being used in temperature sensing applications. You can also find out about MZI-based fiber temperature sensor operation, available fabrication materials, and methods along with some potential applications in temperature monitoring.

Optical fiber distributed temperature sensor (DTS), fiber Bragg gratings (FBG), and tunable diode laser absorption spectroscopy (TDLAS) are often mentioned as three primary techniques for temperature measurement using fiber-optic sensing and spectrum technology. The DTS system continuously monitors the space temperature field along the fiber length in real-time; the FBG temperature sensor can measure the temperature using the Bragg wavelength change, while TDLAS is widely used to obtain the spectral information in various positions around the measurement space. The second chapter introduces basic operational principles of these three techniques, current research progress, and typical temperature sensing applications.

TDLAS used in system monitoring and control inspired authors of the third chapter to write an interesting article about industrial applications of TDLA. You can learn about TDLAS car engine applications, jet engine applications, burner, and plant applications as well as about process monitoring applications.

Unlike previous chapters that dealt with fiber-optic sensing technology, the final chapter presents an interesting experimental investigation based on the application of thermocouple system for temperature measurements. The authors presented a study of simultaneous influence of mechanical strength and cutting conditions on the cutting temperature in the machining of aluminum alloys in an attempt to show that the cutting temperature is greatly affected by the individual variation of the cutting factors as well as by their interactions.

3. Conclusion

The book contains articles that authors chose to publish in an open access way to make their studies and research results visible and applicable to wide audience: professors, students, and professionals. We hope that these excellent contributions that address both theoretical and practical issues of temperature sensing may help readers to come up with new creative ideas and inspire new research projects.

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