Principles of Terahertz Science and Technology

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To my parents Su-Ho Lee and Soon-Im Shin

Preface

Over the last two decades, THz technology has ripened enough that a thorough summary and review of the relevant topics is in order. Many different disciplines such as ultrafast spectroscopy, semiconductor device fabrication, and bio-medical imaging involve the recent development of THz technology. It is an important task to lay down a common ground among the researchers, so that they can communicate smoothly with one another. Besides, the THz community is growing fast and the THz technology is in a transitional period. The THz research activities have mainly focused on generation and detection until lately, but the focal point has shifted to the practical applications such as high-speed communication, molecular spectroscopy, security imaging, and medical diagnosis, among many others.

This book covers a broad range of topics and fundamental issues. Individuals from distinct disciplines have helped developing new THz technologies, and in order to reach the next level, i.e., practical applications, the technology requires its researchers to understand and communicate with one another. This book serves this general purpose by providing the researchers with a common reference, thus bridging "the THz gap".

I have tried to elucidate the fundamentals of THz technology and science for their potential users. This book surveys major techniques of generating, detecting, and manipulating THz waves. It also discusses a number of essential processes where THz waves interact with physical, chemical, and biological systems. Scientists and engineers of various disciplines realize that the THz gap in the electromagnetic spectrum is now accessible thanks to the recent advances in THz source and detection technologies. Many are seeking ways by which they can incorporate the new technologies into their expertise and research agenda. Younger researchers, who wish or are to join THz research groups, would also find this new field challenging due to many barriers, the lack of comprehensive introduction and/or instruction among them. Potential users of THz technology should be prepared in the essential concepts and techniques of THz science and technology; I hope this book be an introductory guide for the new comers.

During the process of writing this book, many colleagues, friends, and students gave me worthy criticism and introduction. Although it is impossible to acknowledge all scientific contributions, I am deeply grateful of those whose works I use in this book. I am much obliged to Joe Tomaino, Andy Jameson, and Jeremy Danielson for their invaluable advice. I am indebted to the National Science Foundation and the Alexander von Humboldt-Foundation for their generous support. Finally, I thank my wife, JungHwa, for her support in every possible ways.

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