J Infrared Milli Terahz Waves (2012) 33:391–392
DOI 10.1007/s10762-012-9887-9

Introduction to the Special Issue on “Photoconductive Emission and Detection of Terahertz Radiation”

Michael B. Johnston

Received: 4 March 2012 / Accepted: 5 March 2012 /
Published online: 16 March 2012

Terahertz science and technology is a research area that has expanded rapidly in the past decade, with terahertz spectroscopy and imaging now becoming important tools in applications as diverse as nanotechnology and industrial quality control. The power of terahertz spectroscopy is based on the ability to generate coherent terahertz radiation and to detect its electric field as a function of time. Photoconductive devices were the key technologies that first enabled such coherent emission and detection, and thus seeded modern terahertz spectroscopy. Intense research into photoconductive device technology is currently leading to devices that are highly efficient, robust and industrially compatible. Furthermore, novel photoconductive devices are stimulating the development of yet more novel forms of spectroscopy, and new applications. This Special Issue is devoted to assessing the present status of photoconductive terahertz technologies and to discussing future challenges facing the field.

The issue consists of five invited papers, which are designed to provide the reader with a comprehensive overview and a summary of up-to-date developments on the main device technologies for generating and detecting terahertz radiation. For readers new to photoconductive devices, these articles also provide an excellent introduction to the theory of THz emission and detection, and review significant breakthroughs from the early 1970s to the present state-of-the-art. The first article, “Photoconductive Emission and Detection of Terahertz Pulsed Radiation using Semiconductors and Semiconductor Devices” by Masahiko Tani and colleagues from the University of Fukui, Japan, provides an introduction to the principles of photoconductive antennas and describes how they have been optimised over the years. The article then focuses on current research directed at producing and detecting *pulsed* THz radiation with devices excited with 1.55 μm femtosecond lasers. In the second paper Bernd Sartorius and co-workers from the Fraunhofer Institute for Telecommunications in Berlin, Germany, review methods to generate and detect *continuous-wave* terahertz radiation in their article “Continuous Wave Terahertz Systems Based on 1.5 μm Telecom Technologies”. They also highlight the latest developments in telecom-based devices, which are currently leading to a new generation of terahertz spectrometers. The third paper, “Polarization-Resolved Terahertz Time Domain

M. B. Johnston (✉)
Department of Physics, University of Oxford, Clarendon Laboratory, Parks Road, Oxford OX1 3PU, UK
e-mail: m.johnston@physics.ox.ac.uk

Spectroscopy", by Enrique Castro-Camus from Centro de Investigaciones en Optica, in Leon, Mexico introduces the exciting devices that are enabling new forms of terahertz spectroscopy. Then Stephan Winnerl from the Helmholtz-Zentrum Dresden-Rossendorf, in Germany provides a detailed and instructive review of highly efficient micro-structured THz emitters in his paper "Scalable Microstructured Photoconductive Terahertz Emitters". In the final invited paper, "THz Photoconductive Antennas Made from Ion-Bombarded Semiconductors" Juliette Mangeney from CNRS Orsay, France, introduces and reviews the latest developments in ion-implantation, which is a key enabling technology for THz photoconductive devices.

Together, these papers give a refreshing overview of the intense international research effort that is being devoted to the devices that are now powering modern terahertz spectroscopy. They also forecast an exciting future for photoconductive terahertz devices and systems.