RIEC & IEEE Sendai-Section

36th Nano-Spin Engineering Workshop

- Terahertz Technology for Tomographic Applications

Date&Time: 9:30am - 12:30pm, April 17th, 2009

Venue: Conference Room, Nano-Spin Laboratory Building 4F
RIEC: Research Institute of Electrical Communication, Tohoku University
2-1-1, Katahira, Aoba-ku, Sendai, 980-8577 Japan

Program:

9:30 - 10:10 **To see where you cannot reach**
Krikor Ozanyan
IEEE Distinguished Lecture, U. Manchester
ABSTRACT: This presentation will give an introduction to hard-field Tomography as an indirect imaging method. The classical case of high energy (X-ray) Computed Tomography will be examined briefly as an example, highlighting the concepts of tomography measurements and mathematical reconstruction. Some criteria for distinction between hard-field and soft-field tomography will be examined, as well as possible interaction and synergy between the two. The challenges for hard-filed Tomography in the optical and THz spectral regions will be examined and exemplified with solutions developed at Manchester. Special emphasis will be given to the current "TempTeT" Project for fast THz Tomography in high-pressure flames.

10:10 - 10:35 **Frequency-agile DAST THz-wave source and its application on free carrier measurement in GaN wafers**
Hiroaki Minamide, Seigo Ohno, and Hiromasa Ito
RIKEN
ABSTRACT: Terahertz-wave (THz-wave) researches have been developed in various fields from basic sciences to industrial applications, because THz-wave exhibits deep penetration to materials and many molecules have inherent spectra in THz-wave region. In order to accomplish comprehensive and novel applications, we have developed frequency-agile THz-wave sources. The obtained intense monochromatic THz-wave has strong interaction with materials and the THz-wave frequency can be designated to any required one or quickly switched between different frequencies. In this report, we demonstrate an ultra-widely tunable DAST-DFG THz-wave source and its application in carrier density mapping of GaN wafers.

10:35 - 11:00 THz wave generators based on photonic and electronic approaches and its applications to THz spectroscopic imaging
TadaoTanabe and Yutaka Oyama
Dept. Material Science, Tohoku Univ.
ABSTRACT: Frequency-tunable pulse/CW THz-waves are generated by exciting a phonon-polariton mode in a GaP crystal, which are based upon non-collinear phase-matched DFG. The tunable range was approximately 0.3–7.5 THz. We have constructed a small-sized GaP THz-wave generator and high-resolution THz spectrometer for practical uses. We have also realized THz-wave generation in CW mode using the GaAs tunnel injection transit time effect diode (TUNNETT) diode. The fundamental-mode THz-waves generate over 0.7 THz. We have demonstrated sub-THz imaging of the defects, heterogeneous structures, water diffusion in timbers and concrete building blocks.

11:00 - 11:15 **(Coffee Break)**

11:15 - 11:40 **Emission and Detection of THz radiation from 2-dimensional plasmons and their spectroscopic applications**
Taiichi Otsuji
RIEC Tohoku University
ABSTRACT: Development of compact, tunable and coherent sources operating at terahertz (THz) frequencies is one of the hottest issues of the modern ultrafast electronics. Two dimensional (2D) plasmons in submicron transistors have attracted much attention due to their nature of promoting emission/detection of THz electromagnetic radiation. This presentation reviews recent advances in emission and detection of terahertz radiation utilizing two-dimensional plasmons in semiconductor heterostructures. Our original dual-grating gate high-electron mobility transistors (HEMT's) are dedicated for those purpose. Their possible imaging/ spectroscopic applications are also presented.

11:40 - 12:05 **Terahertz imaging beyond diffraction limit**
Jun-ichi Shikata, Yuzo Nomura, Hiroshi Yasaka, Hiroaki Minamide, Hiromasa Ito
RIEC Tohoku Univ., RIKEN
ABSTRACT: Spectroscopic terahertz (THz) imaging receives increasing interest due to novel, macroscopic information originated from THz-frequency resonances. However, the spatial resolution is limited to ca. a hundred micrometer due to diffraction limit. In order to overcome the limit, we study both optical and THz techniques: Raman and near-field THz spectroscopies, based on the fact that many resonances in the THz region are both infrared- and Raman-active. THz-frequency coherent anti-Stokes Raman spectroscopy (CARS) is successfully applied to obtain wide-range spectra of biomolecules as well as THz-frequency CARS imaging with the spatial resolution less than 10 □m. Furthermore, surface-plasmon resonances are successfully applied to THz imaging with the spatial resolution around 10 μm..

12:05 - 12:30 **Two topics on THz imaging : THz beam steering and tomosynthesis**
Chiko Otani, Yoshiaki Sasaki, Kenichiro Maki, Naoki Sunaguchi, Tetsuya Yuasa
RIKEN
ABSTRACT: Diagnosis using terahertz (THz) waves holds a great potential for various applications. We are working on the developments of THz technologies for spectroscopy, imaging, sensing and their applications. In this presentation, we will introduce (1) THz beam steering and frequency tuning techniques by the combination of phased array and differential frequency generation (DFG) to realize rapid two dimensional (2D) spectroscopic imaging, as well as (2) THz tomosynthesis tequnique for three dimensional (3D) imaging utilized to demonstrate the CT imaging of a paper phantom on which some characters are written by pencil.

Organizers: RIEC Nano-Spin Engineering Workshop Committee, Tohoku University
IEEE Sendai Section

Contact: Taiichi Otsuji, Professor
RIEC, Tohoku Univ.
TEL&FAX 022-217-6104
Email otsuji@riec.tohokua.c.jp