Michael Shur (Rensselaer Polytechnic Institute)

Title: Terahertz Sensing Technology

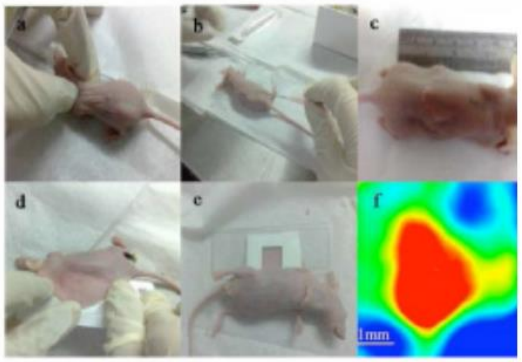
Abstract: In a separate pdf-document

Terahertz sensing is enabling technology for detection of biological and chemical hazardous agents, cancer detection, detection of mines and explosives, providing security in buildings, airports, and other public space, short-range covert communications (in THz and sub-THz windows), and applications in radioastronomy and space research. This lecture will review the-state-of-the-art of existing THz sources, detectors, and sensing systems. As application examples, I will discuss THz space exploration, sensing of biological materials, broadband THz reflection and transmission detection of concealed objects, THz explosive identification, THz nanocomposite spectroscopy, and THz remote sensing.

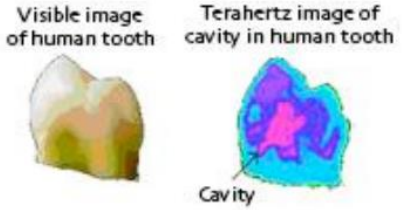
Most existing terahertz sources have low power and rely on optical means of the terahertz radiation. THz quantum cascade lasers using over thousand alternating layers of gallium arsenide and aluminum gallium arsenide have achieved high THz powers generated by optical means. Improved designs and using quantum dot medium for THz laser cavities are expected to result in improved THz laser performance. Large THz powers are generated using free electron lasers or THz vacuum tubes.

Two-terminal semiconductor devices are capable of operating at the low bound of the THz range, with the highest frequency achieved using Schottky diode frequency multipliers (reaching a few THz). High speed three terminal electronic devices (FETs and HBTs) are approaching the THz range (with cutoff frequencies and maximum frequencies of operation above 1 THz and close to 0.5 GHz for InGaAs and Si technologies, respectively. A new approach called plasma wave electronics recently demonstrated terahertz emission and detection in GaAs-based and GaN-based HEMTs and in Si MOS, SOI, and FINFETs and in FET arrays, including the resonant THz detection. It has potential to become a dominant THz electronics technology.

COBE satellite composite galaxy image at THz wavelengths of 60, 100, and 240 microns. (Photo: Michael Hauser (Space Telescope Science Institute and NASA)



Imaging Breast Cancer
From Optics Express, Vol. 19, No 22
page 21552 (2011)



THz image of human tooth. From http://www.tetechs.com/blog/index.php/entry/terahertz-imaging-is-viable-alternative-to-x-ray-for-dental-imagingThz toot

bio: Dr. Michael Shur is Patricia W. and C. Sheldon Roberts Professor and Director of the NSF I/UCRC "Connection One" at RPI. He is Life Fellow of IEEE, APS, and SPIE, Fellow of OSA, IET, ECS, WIF, MRS, AAAS, life member of IEEE MTT, Sigma Xi, and Humboldt Society, and member of Eta Kappa Nu, Tau Beta Pi, and ASEE. He is Editor-in-Chief of IJHSES, ADCOM member of IEEE Sensor Council, and Member of the Board of Governors and Distinguished Lecturer of IEEE EDS. He is co-founder and Vice-President of Sensor Electronics Technology, Inc. His awards include Tibbetts Award for Technology Commercialization, St. Petersburg Technical University Honorary Doctorate, IEEE Kirchmayer Award, Gold Medal of Russian Education Ministry, and Best Paper Awards. Dr. Shur is a Foreign Member of the Lithuanian Academy of Sciences.