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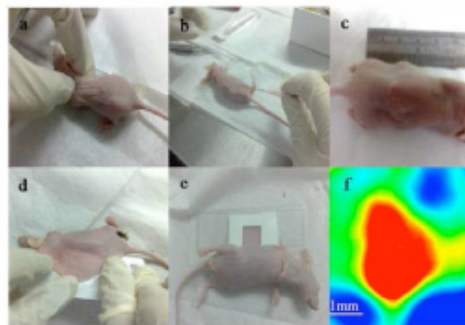
Terahertz sensing is enabling technology for detection of biological and chemical hazardous agents, cancer detection, detection of mines and explosives, providing security in buildings, airports, and other public space, short-range covert communications (in THz and sub-THz windows), and applications 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.

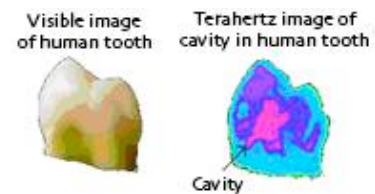
Two-terminal semiconductor devices are capable of operating at the low bound of the THz range, with the highest frequency achieved using Schottky diode frequency multipliers (reaching a few THz). High speed three terminal electronic devices (FETs and HBTs) are approaching the THz range (with cutoff frequencies and maximum frequencies of operation above 1 THz and close to 0.5 THz 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
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THz image of human tooth. From <http://www.tetechs.com/blog/index.php/entry/terahertz-imaging-is-viable-alternative-to-x-ray-for-dental-imaging> Thz tooth