Center for Terahertz Research at Rensselaer

Xi-Cheng Zhang
Center for THz Research @ School of Science, Rensselaer Polytechnic Institute, Troy, NY 12180

The recent developments in THz sensing and imaging technology at Rensselaer are pioneering new ways of seeing and understanding the world. The research currently being conducted will lead to scientific breakthroughs. It will soon be possible for us to see images of electrical fields, diseased tissues, the chemical compositions of plants and much more that is currently undetectable by any other existing imaging systems.

The major contribution to THz sensing technology by Rensselaer Center has been the development of the THz emitter and sensor and applying them to T-ray imaging. In year 2005, 10 companies supported the center and 60 companies contacted the center for information requirement and future collaboration.

Recently, Rensselaer researchers have identified new spectroscopic signatures of several explosive materials in the THz range. We have demonstrated over 30 meters standoff detection of explosives (RDX) in reflective THz wave measurements. This is crucial for rapid and remote screening personnel for concealed weapons and explosive devices. Explosives, concealed directly on personnel, have been responsible for an extensive number of deaths and related damage. By utilizing new technology, such as T-wave imaging techniques, the possibility of detecting concealed weapons and explosives carried by terrorists has been demonstrated. T-waves can be used to illuminate and scan a suspect terrorist from a distance of several meters. T-waves can readily penetrate most clothing materials, enabling the identification of a potential terrorist well before they approach security stations.

Another “killer” application is the reflective measurement of fire damage to aircraft composite materials by using terahertz wave sensing and imaging technology. Rensselaer researchers demonstrated that the reflectivity of these composite fiber materials exhibits strong polarization dependence in the terahertz frequency range due to the linear grain orientation, which is correlated to the structural damage degree. The heat damage causes reproducible alterations to the signal measured by pulsed and continuous terahertz waves. This observation could be extremely important for quality control in both the aerospace and automobile industry. Major aerospace companies are working us for this research and development.

Ms. Zhong and Mr. Xie use THz wave to measure the defects in the space shuttle insulation foams.

The Center currently has five THz labs (the Keck Lab for THz Science, M. Shur’s THz Electronics, M. Yamaguchi’s THz Quantum Optics, I. Wilke’s THz Spectroscopic Lab., G.C. Wang’s IGERT THz-GHz Lab, and X.-C. Zhang’s THz Optics). These laboratories are well-equipped with pico-second and femto-second photonic and optoelectronic instrumentation. There are nine state-of-the-art femto-second laser systems in the labs. The Keck Lab for THz Science’s 2,000 square feet research area is located within a class 10,000 clean room. Installation of the optical tables and laser equipment commenced in September 2003 and was completed by November that year.

Currently, the Center is supported by NSF, DOE, ARO, DARPA, HSARPA, NASA, and more than ten industrial companies. It is closely linked with the only THz NSF program in this country (see http://www.rpi.edu/dept/phys/graduate/igert.html)