

# American Chemical Society session to focus on T-rays - the next wave in imaging technology

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A versatile technology that can spot cracks in space shuttle foam, while also offering the potential to see biological agents through a sealed envelope and detect tumors without harmful radiation, will be the focus of a full-day symposium at the 230th national meeting of the American Chemical Society in Washington, D.C. The session will be co-chaired by T-ray experts Xi-Cheng Zhang, a physicist and engineer at Rensselaer Polytechnic Institute, and Charles Schmuttenmaer, a chemist at Yale University.

T-rays are the next wave in imaging and sensing technology. Based on the terahertz (THz) region of the electromagnetic spectrum -- defined by frequencies from 0.1 to 10 THz, just between infrared light and microwave radiation -- T-rays are opening the door to a wide variety of applications.

"The last 20 years have seen a revolution in pulsed THz science and technology," says Zhang, the J. Erik Jonsson '22 Distinguished Professor and director of the Center for Terahertz Research at Rensselaer. "It is an extremely attractive research field with interest from sectors as diverse as the semiconductor materials, medical, manufacturing, space, and defense industries."

Zhang and Schmuttenmaer planned the symposium to introduce T-rays to the analytical chemistry community. Twelve invited speakers will

discuss various aspects of the technology at the symposium, "Analytic Applications of Terahertz Spectroscopy," which will take place from 8:30 a.m. to 4:45 p.m. Tuesday, Aug. 30, in Room 155 of the Washington Convention Center.

Objects at room temperature emit thermal energy in the THz range. This radiation is extremely useful for sensing and imaging objects, with major advantages over other techniques, according to Zhang. T-ray systems offer more than just images: they can provide valuable spectroscopic information about the composition of a material, especially in chemical and biological species -- something that X-rays may not be able to do. T-rays are also safer than X-rays for biological applications, Zhang says, with photon energies that are 1 million times weaker than X-ray photons.

Until recently, researchers have had great difficulty harnessing the potential of the THz region, largely because of a lack of suitable radiation sources. Zhang will demonstrate new advances achieved at Rensselaer that allow for the sensing of extremely small objects on the nanometer scale, as well as at large distances of more than 100 meters -- an essential improvement for national security applications such as remote sensing of explosives. He will also discuss recent collaborations with NASA, where THz imaging successfully detected defects in space shuttle foam.

Other speakers will discuss T-ray applications that could enable the label-free characterization of genetic material, detect a C-4 explosive hidden in the mail, and help researchers understand the complex dynamics involved in protein folding.

Advanced materials research has provided new and higher power sources, and interest in THz sensing and imaging has exploded as a result. "Biomedical imaging and genetic diagnostics are two of the most

obvious potential applications of this technology," Zhang says. "But equally promising is the ability to investigate material characteristics, probe distant galaxies, and study quantum interactions."

Zhang leads the Center for Terahertz Research at Rensselaer, where more than 30 scientists actively conduct research and development in THz wave science and technology. A decade ago at Rensselaer, Zhang was the first to use zinc-tellurium crystals as pulsed THz wave sensors. Now the zinc-tellurium THz emitters and detectors are used in more than 100 laboratories around the world.

A \$1 million grant from the Keck Foundation helped provide the center's 5,000-square-foot Keck Laboratory with state-of-the-art equipment. Scientists and engineers from more than 100 universities, companies, medical schools, and clinics have visited Rensselaer's THz facilities, and the THz team has helped scientists from 25 countries learn to use the technology. Zhang holds 13 patents, with more pending.

Zhang is one of 18 Rensselaer researchers presenting at the ACS meeting in Washington, along with Rensselaer President Shirley Ann Jackson, who will be speaking at a special event celebrating the 10th anniversary of the ACS Scholars Program. Her talk will focus on the urgent need to build the next generation of scientists, which she asserts requires fostering a national plan and a national will to succeed.

Source: Rensselaer Polytechnic Institute

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