OAK RIDGE NATIONAL LABORATORY FACT SHEET
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

ORNL Coherent Infrared Camera Enables Chemical Plume Detection and Tracking

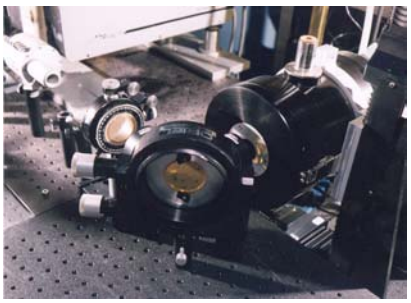
Active Infrared Camera can detect chemicals at long distance

Imaging Coherent Optical Receiver developed under ORNL LDRD Program

Oak Ridge National Laboratory (ORNL) has been developing advanced infrared heterodyne receivers for plasma diagnostics in fusion reactors for over 20 years. Passive heterodyne radiometry in the LWIR region of the spectrum has historically been restricted by HgCdTe (MCT) detector technology to receiver bandwidths of only 2 GHz. Given typical atmospheric line widths of approximately 3 GHz, a CO_2 (or isotope) laser local oscillator with an average line spacing of 50 GHz, and an MCT detector, only chemical species whose absorptions fall directly on top of laser lines can be measured. Thus, with traditional narrow-band heterodyne radiometry, much of the LWIR spectrum is missed and the less complex direct detection DIAL has been the preferred technique in remote sensing applications. Wide-band imaging heterodyne receivers offer significant improvements in remote measurement capability. Progress at the National Research Counsel of Canada and at ORNL in wide-band quantum-well infrared photodetectors (QWIPs) and receivers is significantly enhancing the bandwidth capabilities of heterodyne radiometers. ORNL recently made measurements in the lab using QWIPs developed at NRC of Canada that demonstrate heterodyne quantum efficiencies of 5% with a heterodyne bandwidth of 8 GHz. The path forward indicates that > 10% heterodyne quantum efficiencies and 30-GHz bandwidths are achievable with current QWIP technology. With a chopped, 30-GHz passive heterodyne receiver, a much larger portion of the LWIR spectrum can now be covered. The heart of the imaging receiver is an array of these quantum-well infrared photodetectors and an ORNL-developed compact RF-driven CO_2 laser. Under an internally funded R&D program called Coherent Infrared Imaging Camera (CIRIC), ORNL has developed, tested and patented a design for a 10-micron coherent imaging receiver.

CIRIC Characteristics

- Each CIRIC pixel is an independent laser radar receiver
- It enables long-range chemical detection
- It has hard-body and aerosol imaging ladar capability
- CIRIC can respond to both active or passive measurements



CIRIC Receiver Prototype.

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