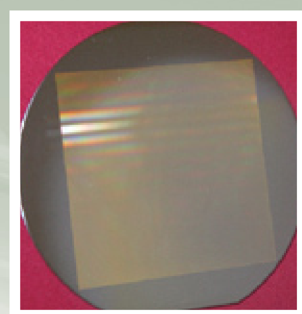
Dualband Quantum Well Infrared Camera for Target Identification

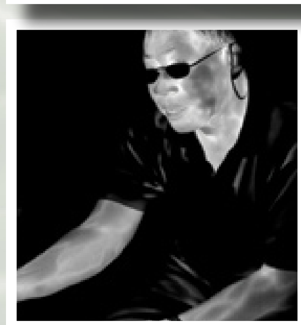
Accomplishment: The first dualband infrared detector array operating in the longwave / longwave regime was developed and characterized. This detector was made possible by a unique quantum well infrared detector architecture.

Impact: This advancement provided the technical basis for follow-on development of a midwave / longwave dualband detector array and camera with improved sensitivity needed for remote temperature measurement and target identification. This camera has been validated in field tests to identify and track airborne vehicles and to give early missile warning and identification. These cameras can be used for a wide range of other applications, including buried landmine detection and astronomical observations.

Motivation and Approach: Infrared cameras are used for imaging of land-based threats such as tanks, missile launchers and buried landmines; for early missile warning and tracking; and for space situational awareness. Until recently, conventional infrared detectors based on mercury-cadmium-telluride or indium-antimony typically could detect only one specific wavelength of infrared light, but at least two wavelengths are needed simultaneously to measure temperature. The ability to quantify temperature, rather than simply to detect heat, gives the added essential capability to positively identify targets. Mercury-cadmium telluride can now provide dualband detection, but with relatively low signal uniformity, only limited detector array size and relatively high noise that depends on the signal frequency. Dualband detection can also be achieved with two different cameras, or one camera with a complex set of filters that are inserted into the light path, but these approaches add considerable cost, weight, volume and maintenance.

Quantum well infrared photodetectors consist of 30 to 50 pairs of alternating semiconductor layers such as gallium arsenide and aluminum-doped gallium arsenide. Each layer is 5-10 nanometers thick, which forces electrons into specific energy levels that absorb infrared radiation at a specific wavelength that can be tailored by controlling the composition and thickness of the layers. Dualband detectors are constructed by placing a set of layers tuned for one wavelength on top of another set of layers tuned for a different wavelength. Each stack absorbs infrared radiation within a specified wavelength band, but allows other wavelengths to pass through. This design approach was developed and validated in this accomplishment. The detectors were developed at the Jet Propulsion Laboratory through funding from the Air Force Office of Scientific Research and the Space Vehicles Directorate, they were characterized for the space environment with a low thermal background at the Space Vehicles Directorate, and they were transitioned into commercial applications by the Jet Propulsion Laboratory and Indigo Systems, Inc. (now part of FLIR Systems, Inc.) through funding from the Missile Defense Agency.





Team: Research at the Space Vehicles Directorate was conducted by Dr. Dave Cardimona and Dr. Anjali Singh (currently with Northrop Grumman). Research at the Jet Propulsion Laboratory was led by Dr. Sarath Gunapala. This technology has been transitioned by Indigo Systems, Inc. (now part of FLIR Systems, Inc.).