

RIT Center for Detectors Advances Astronomical Instrumentation

November 2013

RIT scientist Don Figer, director of the Center for Detectors, is collaborating with Raytheon Visions Systems to advance a new family of large-format infrared detectors grown on silicon wafer substrates.



NASA and the National Science Foundation awarded RIT \$1.1 million and \$1.2 million, respectively, to design, fabricate, and test the hybrid detectors developed by Raytheon, one of the leading providers of detectors and focal plane arrays for ground-, airborne-, and space-based applications.

RIT-Raytheon detectors could represent a leap forward in infrared astronomy by increasing the size of infrared detectors, improving performance, and lowering cost. The technology someday could support future NASA missions to understand the nature of dark matter and dark energy, find Earth-like exoplanets, and enhance NASA's Planetary Science and Earth Science space missions to study weather, climate, and air pollution. The NSF-funded portion of the project could help realize large ground-based telescopes and impact the fields of remote sensing and medical imaging.

"The search for dark energy and dark matter are the major goals for space astronomy missions in the next decade, according to the National Research Council's Decadal Survey," Figer says. "High-performance detectors are also essential for the Wide Field Infrared Survey Telescope, the mission envisioned to achieve this goal."

For the last 15 years, scientists have pursued the use of silicon substitutes in the quest for large infrared detectors. Until now, the crystal lattice mismatch between silicon and infrared materials has stymied advancement, causing defects that generate higher dark current and noise, reduce quantum efficiency, and increase image persistence.

The wide commercial application of silicon, and the existing infrastructure built around the semiconductor industry, would drive down the cost of building detectors based on silicon substrates. Silicon's high-volume production and large format make silicon wafers an attractive alternative to Cadmium Zinc Telluride wafers.

Small-scale, precious, and expensive Cadmium Zinc Telluride wafers are in standard use now. Raytheon's novel technique deposits light-sensitive material onto silicon substrates while maintaining high vacuum throughout the multistep process. The material growth is done with molecular beam epitaxy, a technique common to the semiconductor industry and pivotal to moving beyond the constraints inherent in the standard infrared detector technology.

The RIT-Raytheon device will have broad wavelength coverage that extends from the optical to the infrared in standard-sized arrays of 1,024 by 1,024 pixels or 2,048 by 2,048 pixels and will scale upward to 14,000 by 14,000 pixels. This leap reflects the Center for Detectors' strategic goal to build and use advanced astronomical instrumentation, Figer says.

"Raytheon has come up with an innovation to combine the silicon wafer with the mercury cadmium telluride light-sensitive layer in a way that could end up dominating the field of infrared detectors for the next 20 years," Figer says. "It could push the boundaries of what is possible."