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Uncooled Infrared Detectors with High Sensitivity

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Uncooled Thermal Sensors

Current uncooled infrared sensors are broadband devices that are not sensitive enough to use narrow spectral lines to detect trace amounts of material. Their performance is fundamentally limited by excessive background noise levels that prevent the sensor from identifying “hot spots” and cause other inaccuracies. Uncooled infrared detectors have traditionally been limited to detecting single gases because they need special wavelength-selective filters. Additionally, the mid-wave infrared (MWIR) region (3-5 microns) is susceptible to interference from thermal sources in the long-wave infrared region (LWIR). A thermal sensor has been developed that showcases tunable detection and a modified microbolometer architecture to maximize sensitivity and chemical identification accuracy.

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Modified Microbolometer Detects Infrared Spectrum

This new sensor forgoes the single-frequency filter and allows a range of frequencies to be detected, allowing for applications such as multi-gas identification. Frequencies that fall outside of this infrared (IR) range (said to be “off-resonance”), are reflected so as to produce a selective, pure signal. The MWIR region is protected from LWIR waves by a modified microbolometer that is composed of materials that absorb MWIR waves but not LWIR waves.

Chemical Detection with Uncooled Sensor

The sensor can recognize unique absorption spectra of gases which allow the detector to “see” the chemical fingerprint region of the gas as easily as cooled sensors without the cost, weight, and overhead associated with external cooling. Furthermore, it can scan any desired set of wavelengths across the infrared spectrum without the limitations of fixed filters using a tunable detection method. By eliminating noise from unneeded portions of the IR spectrum, tunable detection leaeds to 10-100 times the sensitivity than comparable uncooled sensors. Ultrahigh sensitivity can be achieved by using a support structure with extremely high thermal isolation that ensures the thermal conductance noise is below the standard radiation level.

This improved thermal detector has applications in multi-gas, handheld detection equipment for first responders and can provide a “point and click” method of chemical detection. Higher sensitivity and tunable detection allows for especially high-precision mid-range thermal detection.

FEATURES AND BENEFITS OF UNCOOLED INFRARED DETECTOR:

- 10-100 times more sensitive in the MWIR range
- Requires few changes to the existing microbolometer architectures and does not require an optical cavity
- The uncooled infrared detector has much higher sensitivity than existing uncooled devices (at least one order of magnitude)
- The uncooled infrared detector allows trace chemical detection from a distance using a “point and click” method

Phase of Development Conceptual

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https://license.umn.edu/product/uncooled-infrared-detectors-with-high-sensitivity