NISTTech

PROCESS AND APPARATUS FOR THE MEASUREMENT OF THERMAL RADIATION USING REGULAR GLASS OPTICS AND SHORT-WAVE INFRARED DETECTORS

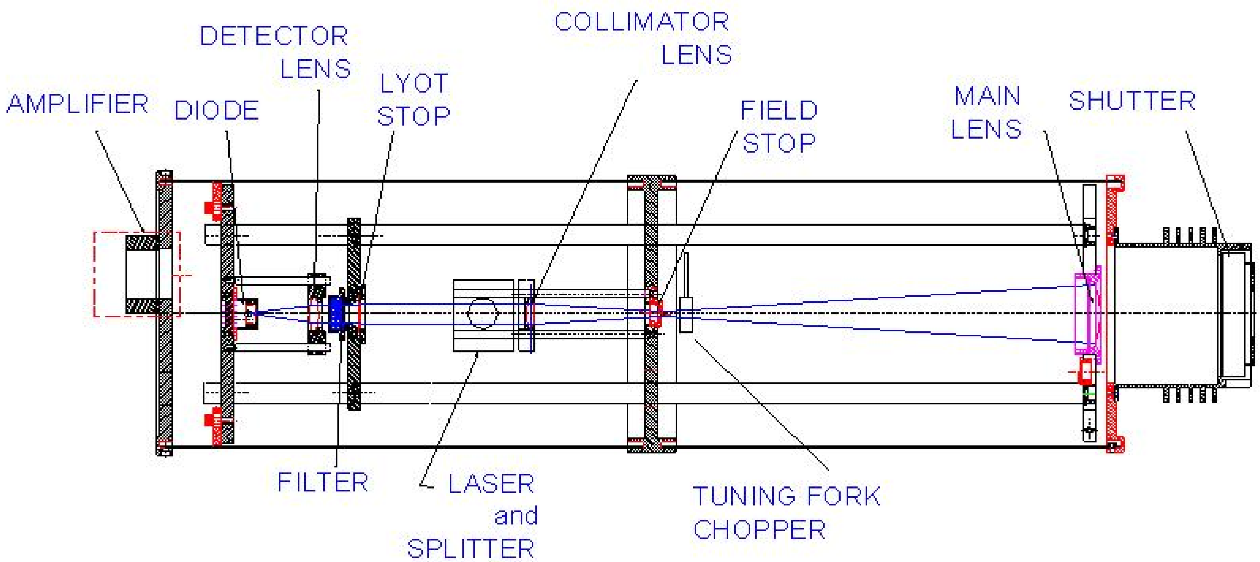
Detect infrared radiation from distant objects without requiring special cryogenic cooling or infrared transmitting optical materials; Temperature Measurements Using Thermo-Electric Cooled Short-Wave Infrared Detectors

Description

Measure infrared radiation emitted by objects at near ambient and higher temperatures using this novel radiation thermometer. The device, which operates in the near infrared spectral region of 2.0-2.5 microns, uses regular glass optical materials and conventional low temperature photon detectors that are cooled with a thermo-electric refrigeration system.

Detecting surface temperature at near ambient conditions is important in applications ranging from surveillance and non-destructive testing to accurate detection of hot objects at great distances.

Images



Schematic drawing of the radiometer

Applications

- **Temperature measurements**
  Detects the temperature of objects from a distance even when blocked by glass
- **Surveillance**
  Small size and dependable

Advantages

- **Transmits through glass**
  This radiometer is capable of "seeing" through glass to detect heat sources within a dark car
- **Low NEI and NETD**
  Very low noise-equivalent irradiance (NEI)and noise-equivalent temperature difference (NETD)
- **Improved contrast**
  Provides good contrast between the target and surrounding scenery
- **Low costs**
  Cryogenic cooling is not required, so costs are low, size is compact and maintenance is easier

Abstract

The invention is an apparatus and the associated process to measure thermal radiation from ambient-temperature objects using short-wave infrared detectors and regular-glass optics. The detectors are chosen to operate in the wavelength region from 2.0/lm to 2.5/lm in an atmospheric window between absorption bands. The selection and thermo-electric cooling of the detectors for high shunt resistance and decreasing the background signal with a field-of-view limiter results in directivity, D*, of 4 x 1013 cm Hzl/2tw which is near the background-limited performance at 295 K. Furthermore, the use of the regular glass optics to collect the thermal radiation results in diffraction-limited imaging. The secondary imaging inside the apparatus enables the use of an internal chopper at the field stop and the use of a field-of-view limiting Lyot stop. The chopped signal can be further increased by the use of a self-staring effect with a reflective modulator. The use of a radiation thermometer constructed with these elements for the measurement of a blackbody from 20°C to 50 °c results in noise-equivalent temperature difference (NETD) of < 3 mK at 50°C. The operation at shorter wavelengths than traditional thermal imagers also leads to lower sensitivity to the emissive of the object in determining the temperature of the object. These elements are used to construct a calibrator for an infrared collimator with a 50 mm diameter entrance pupil, and such a system demonstrates noise-equivalent irradiances (NEI) of < 5 fW/cm2o These results indicate that thermal imagers using short-wave infrared sensors could be constructed utilizing regular-glass optics with possible better imaging performance and lower NETD than existing, cryogenically-cooled thermal Imagers.

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Citations

1. H.W.Yoon and G.P. Eppeldauer, Measurement of thermal radiation using regular glass optics and short-wave infrared detectors. Optics Express, Vol. 16, Issue 2,

pp. 937-949, 2008. doi:10.1364/OE.16.000937

Related Items

- Transfer and working standard radiometers and photometers

References

- U.S. Patent #8,119,987 issued 02-21-2012, expires 02/24/2030
- Docket: 08-005

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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