NISTTech

Domain Engineered Ferroelectric Optical Radiation Detector with Multiple Domain Regions for Acoustic Dampening

Reduce acoustical noise and improve detection of optical beams via a single pyroelectric detector

Description

This thermal or pyroelectric detector uses a single crystal having reversed domain polarization regions that provides acoustic nulling, beam detection and dampening of acoustic ringing and acoustic resonances. Acoustic nulling is achieved by combining the outputs of the reversed domain polarization regions. Detection of optical beams and determination of location of the optical beam on the electret results from the pyroelectric effects of the electret. The reversed domain regions can be placed in a periodic pattern that is related to the speed at which the acoustic noise travels through the electret to allow nulling of standing or traveling waves. Additionally, acoustic noise is physically dissipated and scattered by the introduction of multiple domain regions that further reduces acoustic ringing. For example, the introduction of needle domains functions to scatter and dissipate acoustic waves in the electret.

See continuation-in-part U.S. patent below under Citations.

Applications

- **Infrared detectors**
  An infrared image can be projected on a pyroelectric plate and transformed into a relief of polarization on the surface
- **Radiometry**
  Measures the power generated by a radiation source
- **Pyrometry**
  Measures the temperature of a remote hot body with corrections due to deviations from the blackbody emission
- **Solar energy**
  Converts solar energy to electrical power
- **Other**
  Applications in refrigeration, information storage, and solid-state science

Advantages

- **Better measurements**
  Acoustic noise can be nulled by combining the outputs of the oppositely poled regions of the electret in a single crystal. Additionally, interfaces in the domain region dissipate and scatter the acoustic noise and reduce the acoustic ringing and resonances that may occur in the crystal
- **Avoid temperature variations**
  Temperature variations between separate crystals do not occur using a single crystal
- **Reduce acoustical noise generated by waves**
  Reduces acoustic noise from standing and travelling acoustical waves generated by radiation pressure from pulsed lasers that are detected by the electret. Proper sizing and shaping of the alternating reversed polarization domain regions allows for the nulling of standing acoustic waves
- **Simple and inexpensive**
  Uses shadow masks to produce numerous bi-cells and multiple cell reverse domain region crystals in a simple and inexpensive manner

Abstract

A pyroelectric detector with significantly reduced microphonic noise sensitivity that includes a pyroelectric detector element constructed from a z-cut $LiNbO_3$ or $LiTaO_3$ electret. Selective domain reversal is accomplished in the electret by applying an electric field. Electrodes are attached to either surface of the electret spanning the domain reversed region and a portion of the original domain region to create areas of equal and opposite sensitivity. The detector is mounted in an electrically grounded container or housing. The detector may also be constructed having multiple detector regions to accommodate resonant acoustic frequencies of the electret, to function as a position sensor, or both. In other words, the position sensor has multiple domain regions that also accommodate acoustic frequencies. The detector may also be constructed having domain reversed regions placed on the electret in a periodic pattern having a geometry and spacing that is related to the acoustic impulse response of the electret. Needle domains may also be interspersed in portions or throughout the electret to scatter acoustic waves and thereby reduce acoustic noise. Multiple detectors can be produced in a simple and inexpensive manner using shadow masking techniques.

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Citations

1. ***NIST Docket Number:*** 97-017CIP
   U.S. Patent # 6,630,671

References

- U.S. Patent # 6,114,698 issued 09-05-2000 , expires 01/30/2018
- Docket: 97-017US

Status of Availability

This invention is available for licensing.

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