TreMonti

Nanothermocouple single-photon color-sensitive uncooled light detector

Light detection using a nanothermocouple as sensor

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Inventors
Dr. Tito E. Huber, Ph.D.

Field
Optical based quantum computing, optical mixers, infrared sensors, and telecommunications

Technology
Method for light detection utilizing a high efficiency BiTe nanothermocouple as a quantum light sensor

Key Features
-Quantum detection without the use of cryogenic cooling
-Application of nano-wires to improve thermocouple efficiency
-Method for creating reliable electrical contacts using BiTe nanowires

Stage of Development
Concept stage, proof of principle has not been demonstrated.

Status
Seeking a optoelectronics component manufacturer or system designer as partner

Patent Status
Patent Pending

Technology

This invention enables quantum detection at room temperature without the use of the cryogenic cooling systems typically required to deploy such devices. Control of the heat produced by the light sensing device is performed using bismuth telluride (BiTe), the material shown to have the highest thermoelectric efficiency at room temperature. Furthermore, forming BiTe as nanowires creates a thermocouple with a very low thermal mass that further increases thermoelectric efficiency. To create BiTe nanowires capable of supporting reliable electrical contacts, the invention describes a two phase nanowire manufacturing process using pressure injection of molten BiTe into an alumina template followed by etching to create separate nanowires for bonding.

Potential Application

Cryogenic arrays of Ge:Ga or Si:As photoconductors have been used as far infrared detectors for astronomical applications. The need for liquid helium to cool the photoconducting array has severely limited the lifespan of satellite based deep space exploration systems using this technology. Although systems such as IRAS (Infrared Astronomical Satellite) have transformed infrared astronomy, the satellites used were in operation for as little as 10 months until their supply of liquid helium expired. Using the described invention, satellite-based photoconducting arrays could be developed which would obviate the use of a cryogenic coolant thereby greatly extending the lifespan of the satellite.

Opportunity

Overall, the global market for optics and optoelectronics is $500 billion. This technology has the greatest potential application within the photonics sensor segment of the optics and optoelectronics market. Sized at approximately $5 billion, the sensor segment is expected to grow at 10% per year over the next three years due to strong demand for optic sensors used in telecommunication, chemical and biomedical applications.

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INVENTOR:
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EDUCATION
Ph.D., Physics, Brown University, 1982
M.S., Physics, Brown University, 1978

SPECIALTY
Nanocomposite Synthesis and Thermal Resistance across Interfaces

RECENT PUBLICATIONS

"Diameter-dependent thermopower of Bi nanowires"A. Nikolaeva, T.E. Huber, D. Gitsu, and L.Konopko. *Physical Review B* 77, 035422 (2008). Open URL http://arxiv.org/abs/0711.0010.

"Quantum confinement and surface-state effects in bismuth nanowires". T. E. Huber, T.E. Huber, A. Nikolaeva, D. Gitsu, L. Konopko, and M.J. Graf. *Physica E*: *Low-Dimensional Systems & Nanostructures* 37(1-2), 194-199 (2007).

"Pressure dependent thermopower of individual Bi nanowires." D. Gitsu, L. Konopko, A. Nikolaeva and T.E Huber. *Appl. Phys. Lett.* 86, 102105 (2005).

"Peculiarities of thermopower in Bi microwires at low temperatures." D. Gitsu, T. Huber, L. Konopko, and A. Nikolaeva. *Phys. Stat. Sol.(b)*, 242 2497 (2005).

"Confinement Effects and Surface Charge in Bi Nanowire." T.E. Huber, A. Nikolaeva, D. Gitsu, L. Konopko, C.A. Foss, Jr. and M.J. Graf. *Applied Physics Letters* 84, 1326 (2004).