Low-Duty-Cycle Continuous-Wave Photoconductive Terahertz Imaging and Spectroscopy Systems

Tech ID: 24299 / UC Case 2014-941-0

SUMMARY

Professor Mona Jarrahi in the UCLA Department of Electrical Engineering has developed a technique for operating continuous-wave (CW) terahertz imaging and spectroscopy systems based on photoconductive terahertz sources and/or detectors that uses a low-duty-cycle optical pump, achieving high radiation powers and detection sensitivities without causing thermal breakdown, as well as higher quality image and spectra data.

BACKGROUND

The scope and potential use of existing terahertz imaging and sensing systems (both commercial and laboratory scale) are limited by the low power of terahertz sources and low sensitivity of terahertz detectors. Photomixers are a highly promising source of CW terahertz radiation, with excellent frequency tunability and high spectral purity at room temperature operations. Photomixing, also known as photoconductive mixing, involves pumping a high-speed photoconductor integrated with a terahertz antenna with two frequency-offset pump lasers. These systems operate continuously in time, which makes them very sensitive to thermal breakdown and subsequently, device failure.

INNOVATION

In order to address the thermal breakdown limitation and offer better device performance for terahertz imaging and spectroscopy systems, Professor Mona Jarrahi in the UCLA Department of Electrical Engineering has developed a technique that uses a low-duty-cycle optical pump. Systems based on this technique run in operation cycles followed by a sleeping cycle, both of which are determined by the duty cycle of the optical pump. During the operation cycles, the terahertz source and detector are pumped and the generated and detected terahertz waves are used to produce the output image and spectra. During the sleeping cycle, the terahertz source and detector are not pumped, allowing the device to cool down while not producing any output data. This technique achieves higher radiation power, higher detection sensitivity, and higher quality image and spectra data without the risk of device failure due to thermal breakdown.

APPLICATIONS

- Terahertz imaging and spectroscopy systems for:
- Chemical sensing
- Gas sensing
- Atmospheric and space systems
- Quality control systems for:
- Pharmaceuticals
- Food and agricultural products
- Security sensing
- Industrial quality control
- Medical imaging and diagnostics

ADVANTAGES

This technique enables the user to increase the optical pump power at each operation cycle while maintaining a low average optical pump power, allowing for, without thermal breakdown:

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Jarrahi, Mona

OTHER INFORMATION

KEYWORDS

terahertz radiation, photoconductors, imaging, detection, sensing, spectroscopy, duty cycle, pumping, cooling, optics, photomixing, thermal breakdown

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - Medical
  - Other
  - Security
- **Security and Defense**
  - Screening/Imaging
- **Sensors & Instrumentation**
  - Other
- **Engineering**
  - Other

RELATED CASES

2014-941-0

- Higher radiation power
- Higher detection sensitivity
- Higher quality image and spectra data

STATE OF DEVELOPMENT

The performance of this technique has been demonstrated for a photoconductive terahertz source in CW operation. At an average optical pump power of 150mW with a pump modulation frequency of 1MHz and pump duty cycle of 2%, up to 0.8mW radiation power at 1THz has been demonstrated within each continuous wave radiation cycle. Current and future efforts are focused on the use of this technique for developing high performance terahertz imaging and sensing systems.

PATENT STATUS

Country	Type	Number	Dated	Case
Japan	Issued Patent	6955337	10/05/2021	2014-941
Germany	Issued Patent	3155702	12/16/2020	2014-941
France	Issued Patent	3155702	12/16/2020	2014-941
United Kingdom	Issued Patent	3155702	12/16/2020	2014-941
United States Of America	Issued Patent	10,120,263	11/06/2018	2014-941

RELATED MATERIALS

- Christopher W. Berry, Mohammad R. Hashemi, Sascha Preu, Hong Lu, Arthur C. Gossard, and Mona Jarrahi. High power terahertz generation using 1550nm plasmonic photomixers. Applied Physics Letters, 105, 011121 (2014), DOI:http://dx.doi.org/10.1063/1.4890102

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Infrared Detectors And Heat Recycling Cells Based On Metallo-Graphene Nanocomposites
- Terahertz Endoscopy Through Laser-Driven Terahretz Sources And Detectors
- Scanning Terahertz Nanoscopy Probe

UCLA Technology Development Group

10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095

https://tdg.ucla.edu

Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu