Scanning Terahertz Nanoscopy Probe

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CONTACT

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

INVENTORS

- Jarrahi, Mona

OTHER INFORMATION

KEYWORDS

scanning terahertz nanoscopy, terahertz, plasmonic, biomolecules, dynamics, label-free, AFM, STM, spectroscopy

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Biotechnology**
  - Other
- **Engineering**
  - Engineering
- **Imaging**
  - Molecular
- **Medical**
  - Imaging
- **Sensors & Instrumentation**
  - Scientific/Research

RELATED CASES

2017-780-0

SUMMARY

UCLA researchers in the Department of Electrical Engineering have developed a Scanning Terahertz Nanoscopy (STN) system with significantly improved detection sensitivity and spatial resolution.

BACKGROUND

Microscopic studies of the structural dynamics of biomolecules have been challenging, since methods like atomic force microscopy (AFM) present various spectral and operational constraints unfavorable to biology processes, such as vacuum or low temperature, and methods resembling fluorescence microscopy require labeling near active sites. Terahertz (THz) waves offer an alternative approach for label-free dynamic characterization of biomolecules with THz photon energies matching the binding energies of biomolecules. THz spectroscopy has been demonstrated with high sensitivity to conformational and femtosecond-scale dynamic variations of biomolecules. However, the existing THz spectroscopy systems are limited by their low detection sensitivity and limited spatial resolution. Enhancing the signal intensity and spatial resolution of THz spectroscopy systems will further release its great potential in label-free microscopic characterization.

INNOVATION

UCLA researchers in the Department of Electrical Engineering have developed a Scanning Terahertz Nanoscopy (STN) system with significantly improved detection sensitivity and spatial resolution. The invented STN system utilizes a plasmonic THz source and detector integrated with a novel tapered parallel plate waveguide in a time-domain THz spectroscopy system. The plasmonic THz source and detector provides orders of magnitude higher signal-to-noise ratio compared to existing time-domain THz spectroscopy systems. The tapered parallel plate waveguide focuses THz beam with nanoscale focus dimensions and couples the reflected THz beam from the sample to the plasmonic THz detector. Additionally, the invented STN system utilizes similar surface scanning platforms used in atomic force microscopy any temperature or vacuum requirements, allowing studies of complex biomolecule interactions under native conditions.

APPLICATIONS

- Scanning Terahertz Nanoscopy systems for:

- Biomolecule structural dynamics
- Chemical reaction kinetics
- Pharmaceuticals
- Medical imaging and diagnostics

ADVANTAGES

- Label-free detection
- Femtosecond time-scale resolution
- Conformational variation tracking
- Studies under native reaction conditions

STATE OF DEVELOPMENT

- Prototype under fabrication

PATENT STATUS

Country	Type	Number	Dated	Case
European Patent Office	Issued Patent	3612812	12/04/2024	2017-780
France	Issued Patent	3612812	12/04/2024	2017-780
United Kingdom	Issued Patent	3612812	12/04/2024	2017-780
Italy	Issued Patent	502025000008817	12/04/2024	2017-780
United States Of America	Issued Patent	11,249,017	02/15/2022	2017-780
Germany	Published Application	WO 2018/195429	10/25/2018	2017-780

RELATED MATERIALS

▶ Berry, Christopher W., N. Wang, Mohammad R. Hashemi, M. Unlu, and Mona Jarrahi. "Significant performance enhancement in photoconductive terahertz optoelectronics by incorporating plasmonic contact electrodes." Nature communications 4 (2013): 1622.

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

UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu