A Combined Raman/Single-Molecule Junction System For Chemical/Biological Analysis

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Raman spectroscopy, single molecule electronics, molecular conductance, DNA sequencing, protein sequencing, biosensing, chemical identification

CATEGORIZED AS

- **Engineering**
  - Engineering
  - Other
- **Medical**
  - Diagnostics
  - Other
- **Nanotechnology**
  - Other
  - Tools and Devices
- **Sensors & Instrumentation**

ABSTRACT

Researchers at the University of California, Davis have developed a device for multi-dimensional data extraction at the molecular level to allow one to simultaneously detect the presence of a single-molecule electrically, and to extract a chemical fingerprint to identify that molecule optically.

FULL DESCRIPTION

Recent technological advancements in nanoscience have allowed for the study/manipulation of materials at the molecular and atomic levels yielding a better understanding of how molecular structure influences various chemical reactions, surface interactions, and charge transport dynamics. Instrumentation, including field-enhanced Raman spectroscopy and single-molecule characterization used for nanoscale characterization purposes have resulted in the development of novel techniques in genome sequencing. These techniques can be used to evaluate the vibrational and electronic structure of individual molecules; however, they have proved to be less effective than required for simultaneously extracting multi-dimensional data depicting the optical, electrical, and mechanical properties of individual molecules, in situ due to the complexity in performing these measurements. As a result of these limitations, improvements in single-molecule characterization techniques are required.

Researchers at UC Davis have developed a multidimensional tool capable of simultaneously characterizing both the structural and transport properties of individual molecules through the acquisition of tunneling currents and Raman spectra in a single device. Raman enhancement between two nano-electrodes, combined with direct charge transport measurements, allows for concurrently acquiring electrical, optical, and mechanical information about a single molecule. The correlation of electron transport measurements with enhanced Raman scattering of an individual molecule bound between two nanostructured electrodes results in evidence of single-molecule Raman scattering with millisecond temporal resolution. Such simultaneous data extraction provides information about the chemical fingerprint of a molecule, along with data on its configuration, information concerning the strain applied on individual chemical bonds, and how this relates to charge transport properties within the molecular junction.

APPLICATIONS

- Molecular electronics
- Chemical sensing, analysis
- Spectroscopy, molecular identification

FEATURES/BENEFITS

- Fast, millisecond temporal resolution using a simple device
- Single molecule data acquisition; electrical, optical, mechanical, transport data

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20240393251	11/28/2024	2022-511
Patent Cooperation Treaty	Published Application	WO 2023/114990	06/22/2023	2022-511

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- On-Chip Platform for Single-Molecule Electrical Conductance Measurements
- Broadband Light Emission with Hyperbolic Material
- DNA-based, Read-Only Memory (ROM) for Data Storage Applications

- Medical
- Other

RELATED CASES

2022-511-0

- Hybrid Electromechanical Metamaterials for Optical and Electrical Devices
- RNA-based, Amplification-free, Microbial Identification using Nano-Enabled Electronic Detection

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