NASA SBIR Technologies

Single Molecule Instrument for Surface Enhanced Raman Optical Activity of Biomolecules

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IDENTIFICATION AND SIGNIFICANCE OF INNOVATION

There is no readily available technique to determine the structure or helicity of rare chiral biomolecules, especially, those, which do not exist in crystalline forms or do not have known chemical procedures for racemic resolution. The human body consists of homochiral group of molecules and determining their structure and helicity is important for drug development and understanding the basic role of these molecules in life sciences.

Radiation Monitoring Devices, Inc., (RMD) propose to use sensitive Raman Optical Activity (ROA) technique by exploiting surface-enhanced Raman (SER) signals for measuring the circular intensity difference (CID). Our primary goal is to develop an ROA spectrometer based on (SER) signals to elucidate structural and stereochemical information of biomolecules and chiral molecules in general. RMD will develop an instrument for SEROA, which will include standardized cluster reagents on prepared surfaces of certain biomolecules, which are of interest to NASA and the bio-community. Single molecule detection schemes will be employed to strive for parts-per-trillion sensitivity.

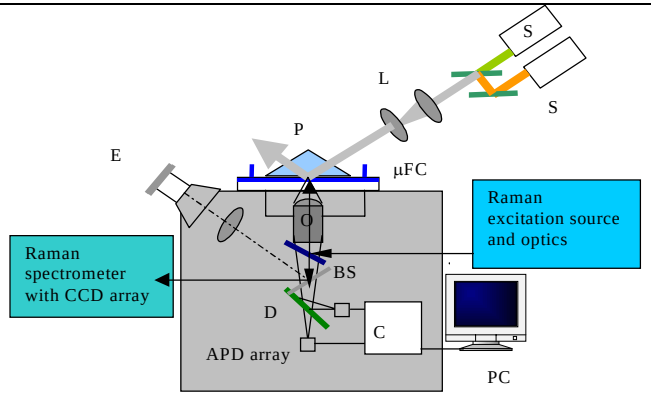

Fig 1. Schematic of the proposed single molecule detection system. S:laser source, L: Lenses, P:Prism for total internal reflection excitation, BS:Beam splitter, D:dichroic, C: Counters and correlators, PC:Computer, E:Eyepiece, O:Objective, µFC: µfluidic channel.

TECHNICAL OBJECTIVES

The goal is to develop and build a single molecule detection instrument for studying structure and helicity of a biomolecule. The method will employ surface enhanced Raman spectroscopy in combination with Raman optical activity to enhance the sensitivity of detection.

WORK PLAN

- Identify and select chiral molecules/biomolecules for SEROA demonstration;
- Assemble and test the classical ROA setup;
- Perform classical ROA experiment and calibrate the system;
- Perform SERS on similar molecules;
- Demonstrate SEROA;
- Analyze the experimental data

NASA and non-NASA applications

NASA applications: NASA's astrobiology program is interested in searching for signs for life on Mars and other planets. One of the goals of this program is to study biomolecular structure and their chirality at concentration levels of parts-per-trillion. Other goals include single molecule studies to understand reaction kinetics, protein dynamics etc.

Non-NASA applications: In research, medicine, drug discovery, and bioassays. It can also be also used for direct determination of helicity and structure for biomolecules in the non-crystalline forms.

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