Laser Ablation - Optical Cavity Isotopic Spectrometer (LAOCIS)

Applied Spectra, Inc.

Technical Abstract
We propose the detailed conceptual development of a device for analyzing key isotopic composition in surface materials without sample preparation. We will combine absorption spectroscopy with laser induced vaporization of solid samples for high-resolution isotopic measurements. An immediate focus is on Mars but our concept is also highly germane to other applications relevant to bio- and geochemical objectives. We will evaluate accuracy, sensitivity, and resolution of our technology for isotopic detection of the key elements associated with signs of life (C, S, H, O) in solid materials. All essential design components of the proposed analyzer have been separately developed and demonstrated in very compact form for other applications. We will demonstrate the overall performance of the proposed technique and build a breadboard prototype instrument. Commercial systems based on the Phase II prototype will be developed and marketed during Phase III.

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2008 Phase II
Proposal S1.09-8929

Lab on a Chip LCVR Polarimeter for Exploration of Life Signatures

Intelligent Optical Systems, Inc.

Technical Abstract
Life on Earth is unique in many ways; one of its great mysteries is that the building blocks of life on Earth (amino acids, nucleotides, sugars) are all chiral. One optical isomer of each amino acid or nucleic acid was selected by evolution. In our pursuit of finding life on Mars and beyond (Triton, Europa, etc.), it is likely that one of the clues to extant or extinct life could be the detection of non-racemic chiral molecules. This proposal describes the development of a highly miniaturized and ultrasensitive lab-on-a-chip polarimeter that will meet the NASA need to measure chirality in very small volumes of samples at very high sensitivity. The proposal builds on a novel technology that is based on a proprietary design, in which a modulated liquid crystal variable retarder (LCVR) enhances sensitivity and reduces size without sacrificing performance. This detection principle with a long-path-length microfluidic flow cell allows for the measurement of chirality in microliter volumes of samples. The Phase I effort has conclusively demonstrated the technical feasibility of the detection principle. A miniaturized polarimeter with microfluidic flow cell was designed and fabricated. The polarimeter was calibrated and tested with samples. In Phase II, we will build, fully characterize, and deliver a miniature polarimeter with optimized performance, enhanced mechanical stability, and integrated fluid handling capability. The primary goals are to further improve the polarimeter's sensitivity, accuracy, size, weight, reproducibility, measurement speed, and power needs, conduct extensive testing, and deliver a robust prototype, engineering drawings, software, and test results to NASA.

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