Development of a 2nd Generation Laser Raman Spectrometer for the Deep Ocean

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Over the past few years, scientists and engineers at Monterey Bay Aquarium Research Institute (MBARI) have successfully developed and deployed the first generation Deep Ocean Raman In-Situ Spectrometer (DORISS). Laser Raman spectroscopy, based on molecular vibrations, allows non-invasive identification and analysis of geo-chemical targets *in situ*. Light from a 532 nm laser interrogates samples, which may be solid, liquid or gas. The Raman scattered light from the target is collected and passed through a series of optics and a holographic grating and recorded on a CCD camera. The first generation instrument was built as a proof of concept. DORISS is deployed on MBARI's remotely operated vehicles Ventana and Tiburon, and controlled by an operator on the ship in real-time. Over the past three years it has been operating reliably and established that Raman spectrometry in the deep ocean is possible. Although DORISS has been successful, it's size and weight restrict operations to vehicles with large payloads. Furthermore, the limited sensitivity of the instrument makes it difficult to detect certain low concentration targets of interest.

Based on the lessons learned from DORISS, the project team is currently developing a second-generation instrument (DORISS2). DORISS2 will be smaller, lighter, and more sensitive than the previous version. DORISS2 will include two new components both of which should increase the sensitivity of the instrument: a back illuminated CCD camera, and a new more compact probe head. Additional improvements to the system include the ability to adjust the laser power output, and the ability to monitor and regulate the spectrometer temperature during deployment. Both systems are built around laboratory-based spectrometers from Kaiser Optical Systems, Inc. While DORISS was comprised of an L-shaped optical bench that required an awkward L-Shaped pressure housing, DORISS2 has a U-shaped optical bench that made housing the instrument much easier. Combining the optics and the electronics into the same housing for DORISS2 will reduce the number of pressure housings. This reduction in weight and size will make the instrument more portable to other deep submergence vehicles.