NuScope Microscope & video camera system for the Chemistry & Geology Departments’ DeltaNu Inspector Raman Spectrometer

Project Lead Name & Contact Info:
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Background & Introduction:
The Chemistry and Geology departments continue to upgrade their capacity to allow students to acquire knowledge and hands-on experiences with modern analytical instruments required for their future careers in graduate school, and government and industrial laboratories. The students obtain expertise with these instruments in both laboratory course in their programs as well as in undergraduate research and capstone courses.

The university’s strategic plan is intended to promote student success. We feel that providing an enhanced exposure to such modern instrumental techniques as part of both laboratory courses and research projects in both these departments will encourage student interest in attending EWU with the intention of becoming well trained scientists for their future careers.

Earlier this year, as a result of EWU equipment enhancement funds, the chemistry department acquired a portable Raman spectrometer and the Geology department a X-ray fluorospectrometer. Both of these instruments are now being used by students to analyse organic compounds, fibers and soil and mineral samples both in research projects and in the developmental design of laboratory experiments for future students.

Raman spectroscopy offers the advantage of identifying various substances by their unique fingerprint, based on the chemical structure of the unknown, and can do so through walls of sealed bags, transparent bottles, flasks, vials, and ampoules without opening the container. Data is retrieved remotely with Blue Tooth technology or USB with a Fujitsu laptop and NuSpec software. This application is for the purpose of enhancing the versatility of the Delta Nu Raman spectrometer by the acquisition of:

The purchase of a NuScope USB microscope will greatly enhance the capabilities of our DeltaNu Inspector Raman spectrometer. The spectrometer will provide our students with meaningful and challenging research projects, will enhance our ability to provide new and interesting laboratory exercises, will allow for in-class demonstrations of the instrument capabilities, and provide our Department Faculty with a new research tool.
Project Goals and Alignment with Eastern’s Academic Strategic Planning Goals:

This application is for the purpose of enhancing the versatility of the Delta Nu Raman spectrometer by the acquisition of:

(1) a NuScope USB microscope that is an attachment for imaging thin films, microelectronic circuits, mineral inclusions, mixtures of organic compounds including explosives and illicit drugs, pigments in art work, identification of narcotics and plastic explosives, and biological tissues. Illumination of the sample surface is obtained with external white light sources or ambient light. The surface image is viewed in real-time with a color video camera using USB Shot software, which allows movie and screen capture, and

(2) Third Party Software: Spectral Raman data archived from spectrometer software can be further interpreted and manipulated with ACD software. ACD/UVIR Processor and Managers are part of ACD/Spectral Manager, the overall spectroscopic processing and data management software that unifies analytical data information of all types into a single interface. Composed of three tightly integrated industry-leading modules, ACD/UVIR Manager provides the ability to manipulate and manage optical spectra while taking advantage of advanced chemical drawing and reporting features. UVIR Processor provides an easy to use interface for peak fitting, baseline correction, analysis and interpretation of Raman spectra along with structure integration and reporting tools.

Advances in optical sensing continue to revolutionize our world, and the field of Raman spectroscopy is now more popular than ever. There is a demand in industry and government labs for students trained in vibrational spectroscopy. Traditionally, Raman spectrometers were too large and costly to incorporate into the undergraduate curriculum. Access was generally limited to research labs, and students would have to depart training areas to access the research facilities. Further, Raman sampling methods and software were not tailored for novice users. The department’s Raman spectrometer provides faculty in chemistry and geology inexpensive and innovative teaching paradigms using Raman spectroscopy in the teaching labs, or the spectrometers are easily transferred to other facilities for other teaching and research projects.

We have been cooperating with Drs. Rick Cox and Keith Carron of Delta Nu in the development of the operating manual for this instrument and in return they have provided EWU with a library of Raman spectra of minerals. Further, the Washington State Patrol’s Crime laboratory on the EWU campus has and will provide us access to authentic standards of a wide range of materials used in forensic analysis i.e. plastics, polymers, fibers, paint and glass fragments.

Acquisition of the NuScope will allow us to analyse (1) significantly smaller samples of pure materials than is possible with the present sampler and (2) individual components of
heterogeneous solid mixtures. The latter is especially important in both forensic samples where usually samples comprise several compounds that can be imaged separately via microscopy. In addition, it is our intention to study the feasibility of ‘fingerprinting’ soils by this technique for both geological and forensic purposes.

Although Raman spectrometry has been used on a limited basis since its discovery in the 1930s, it is only now that portable reliable instruments have become available mainly due to recent advances in laser, microscopy CCD data acquisition and computerised processing technologies. EWU is fortunate in having such an instrument so early in the evolution of this field. The faculty and students in these two departments will be able to make major contributions to development of Raman spectrometry in organic chemistry laboratories, forensic science, mineralogy and soil science.

Goal #1: The development of new laboratory exercises:
The NuScope microscope attachment will allow for the development of a several new laboratory exercises using samples that are typically encountered in a forensic setting. Fibers, paint smears, explosive residues, drug residues, soil particles, glass and plastic fragments, will require the NuScope microscope for proper sample selection, focusing, and subsequent characterization. In addition, forensic samples are usually a mixture of materials. The NuScope will allow the analyst to select one grain or particle residue in a mixed field for characterization and identification.
In the organic chemistry laboratory, it would be used to analyse solid mixtures such as over the counter analgesic drugs as part of an experiment to identify the active ingredient by other physical and chemical tests.
In mineralogy, it would be used to examine the individual crystals within a complex rock thin film samples.

Goal #2: To utilize the Inspector Raman and NuScope microscope for teaching purposes: The NuScope has a built-in video camera allowing for real-time demonstration of the instrument capabilities in both the classroom and laboratory settings. It is important to demonstrate the proper set-up and operation of an instrument to the students prior to any laboratory exercises. The NuScope microscope attachment will provide this possibility.

Goal #3: To provide Senior Capstone Students with challenging and meaningful Research Projects: Forensic scientists typically work with trace amounts of evidence such as soil particles, paint smears, fibers, combustion residues, glass and plastic fragments, drug residues etc. It is a challenge to properly identify evidence material when only a limited amount of material is available for analysis. The NuScope microscope attachment allows one to examine and identify minute quantities of materials. It is important to give our students a realistic sense of forensic
lab work. The Inspector Raman is a relatively simple instrument to use & operate; however, good spectra are only obtained after careful optimization of a set of instrument parameters. Therefore, the Inspector Raman can provide our students with the necessary hands-on experience that will prepare them for future work in an analytical laboratory for both organic and geological samples.

**Collaborative & Interdisciplinary and/or Interdepartmental:**
The Raman spectrometer and NuScope microscope will be available to the faculty and students of the Departments of Chemistry and Geology for research projects, laboratory exercises, and for teaching purposes.

Furthermore, scientists at the WSP Spokane lab (campus lab) are interested in evaluating the capabilities of this portable Raman Instrument as a field instrument and as a laboratory instrument. Bill Schneck, a forensic scientist in the WSP Microanalysis Section, has suggested using the Inspector Raman to examine plastic fusions, and would assist our students with the development and completion of this research project.

**Expected Outcomes:**
Using the Inspector Raman & NuScope in Chem 450 laboratory exercises beginning in the Fall 2006
Incorporating Raman Spectrometry as part of the course material for Chemistry course 450, and using the NuScope video camera for classroom demonstrations beginning in the Fall of 2006
Utilizing the Inspector Raman & NuScope attachment for Senior Capstone and Independent study research projects beginning in the Fall of 2006
Students will be required to present their research findings at EWU’s Student Research & Creative Works Symposium, and encouraged to present their findings at regional or national forensic science conferences.

**Budget and Cost-Effectiveness:**
**BUDGET:**
NuScope: $4400,
ADC software $600,
Supplies (vials, goggles, thumb drive, MS Office $500).
Total=$5500
The purchase of the DeltaNu NuScope attachment for $5500 greatly expands on the capabilities and flexibility of the DeltaNu Inspector Raman, initially purchased for the cost of ~$15,000.
**Timetable:**
Winter through Fall 2006 for development of new lab exercises using the Inspector Raman & NuScope
Winter through Fall 2006 for real-time classroom demonstration of the Inspector Raman & NuScope
Winter through Fall 2006 for use of the Inspector Raman & NuScope in Independent Study Projects
Winter 2007 for use of the Inspector Raman & NuScope in Senior Capstone Projects
Spring 2006 & 7 for presentation of student and faculty research projects at local, regional and national conferences

**Evaluation and Assessment:**
The number of lab courses which utilize the Inspector Raman & NuScope
The number of students which have used the Inspector Raman & NuScope in their research projects (Senior Capstone, Independent Study projects)
The number of research presentations resulting from the use of the Inspector Raman & NuScope

We will send a copy of this application to Dean Soltero as part of your suggestion that we should seek partial funds within the university for this acquisition.