**EE590 Graduate Colloquium**

**Electronic and Optical Materials and Devices Area Seminar**

# Optical Chromatography for Concentration of Biological Samples

by

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The application of laser radiation as a method for the manipulation of microscopic particle suspensions for biological, and microfluidic interests has brought about a revolution in micro-scale research across many different scientific disciplines. It has been shown that a diffraction limited focused laser can be used to trap microscopic particles whose refractive index is greater than their surrounding solvent. Termed Optical Trapping, work in this arena has yielded new methods, techniques and applications that have flourished, and applications of this technology to areas of research involving microscopic systems for analysis, detection, separation and concentration have blossomed. A related technique, Optical Chromatography, used for particle separation involves loosely focusing a laser into a fluid flowing opposite to the direction of laser propagation. When microscopic particles in the flow path encounter this beam they are trapped axially along the beam and are pushed upstream from the laser focal point to rest at a point where the optical and fluid forces on the particle balance. Because optical and fluid forces are sensitive to differences in the physical and chemical properties of a particle, fine separations are possible. Recently, this method has been used to separate spores of different *Bacillus* species based on their optical and fluidic properties. The optical chromatography beam directed into a tailored flow environment housed in a glass flowcell has been adapted to operate as an optically tunable filter for the concentration or bioenrichment of colloidal and biological samples. Application of these methods and further design of fluidic and optical environments will allow for more specific identification, concentration and separation of many more microscopic particle and biological suspensions.

## Biography

Dr. Sean J. Hart has extensive experience in a diverse range of research areas including spectroscopy, laser trapping, optical engineering, physical chemistry, chemical and biochemical separation, statistical data analysis/calibration and artificial intelligence. His projects have ranged from laboratory research to advanced prototype development and deployment for the DoD. These projects have included the development of advanced neural networks used with chemical/physical sensor arrays for fire and nuisance discrimination aboard the ex-USS SHADWELL (the fire-testing platform of the US Navy). Under EPA funding, Dr. Hart developed and field-tested a portable multi-dimensional fluorescence fiber-optic detection system for detecting and characterizing subsurface organic water and soil contamination. This technology was transitioned back to the EPA for their research use at the completion of the project. Most recently Dr. Hart has been pursuing novel colloidal separations using optical pressure. Specifically, he is engaged in biowarfare defense research using a relatively new technique termed optical chromatography. Applications include bulk sample bio-enrichment and purification, sample separation, detection and advanced characterization.