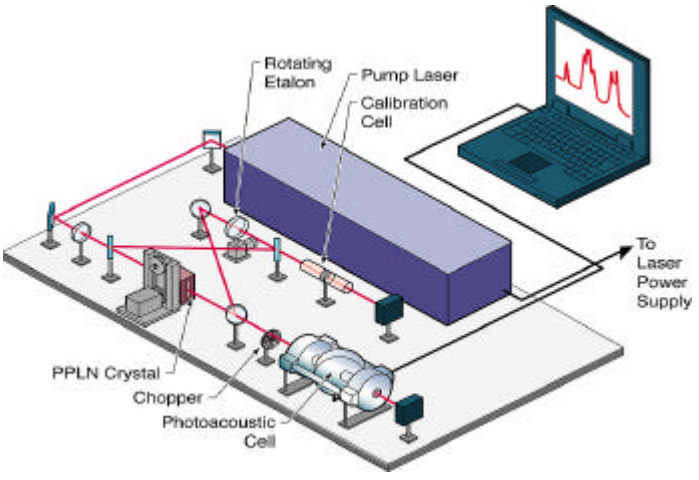
Sensors for VOC/NOx and Metal Particulate Emissions Monitoring

Compliance
CP-1060

Background:
Innovative, cost-effective technologies are required for the Department of Defense (DoD) air emissions control applications to avoid harmful environmental impacts, major compliance-related issues, or cost escalations.

Objective:
This project is developing a portable, laser-based system for combined monitoring of volatile organic compounds/ nitrogen oxides (VOC/NOx) and metals.

Summary of Process/Technology:
For gaseous pollutants, novel, periodically-poled, lithium niobate (PPLN) laser technology is being utilized in a photo-acoustic spectrometer (PAS) in the mid-infrared (IR) range. For metals emissions monitoring, laser induced plasma spectroscopy (LIPS) using currently available solid-state diode lasers for plasma ignition and spark generation is being evaluated for long-term operation. For combined monitoring, a common laser must serve a dual purpose as the pump source for the PPLN laser and the spark source for the LIPS measurement.



Schematic of PPLN Laser and PAS Spectrometer

Benefit:
This technology will allow, for the first time, near real time, in-situ analysis for monitoring a range of species (metals and gases) with higher sensitivity than previously achievable. There are also potential applications in process control and atmospheric chemistry research. Moreover, the compact size of this new system is attractive, and its cost is anticipated to be competitive with many conventional laboratory analytical services.

Accomplishments:
For the IR spectrometer, work has focused on tuning the PPLN, reducing the oscillation threshold, and optimizing the detection sensitivity through the use of acoustically resonant cells. The laser and the photo-acoustic apparatus have been integrated to demonstrate coarsely-tuned photo-acoustic scans over broad ranges in the C-H bond stretching region. For the portable LIPS, a series of experiments using mercury as a surrogate species successfully unraveled the coupling effects of laser wavelength, power density, and sample matrix in plasma initiation and signal detection. To integrate actual hardware, commonality between the IR spectrometer and the LIPS instrument is being exploited to the fullest extent possible without sacrificing performance. The feasibility of sharing the laser source, the sample interaction region, and the operating software are being investigated.

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