

LOW COST OP-FTIR SPECTROMETER WITH NANOSCALE REFERENCE FOR INDUSTRIAL MONITORING – Project Summary

The U.S. Air Force has presented us with the opportunity to develop a compact, low cost open-path Fourier transform infrared (OP-FTIR) spectrometer for measuring the concentrations of organic pollutants in industrial settings. The specific application for this technology is to monitor the air quality inside a hangar where aircraft are being refurbished (where paint strippers among other chemicals are being used). FTIR spectroscopy is an excellent solution to this sensing problem because of its broad spectral response and high sensitivity; these characteristics allow for the detection of numerous molecular species at very low concentrations. The OP-FTIR spectrometer employs a long open air path instead of a sample chamber and uses a Michelson interferometer to impose a different modulation frequency on each wavelength in the spectral region of interest. Commercially available OP-FTIR spectrometers are expensive research grade instruments, however, making them poor candidates for this application. They are high resolution, typically employ a cryogenically cooled mercury cadmium telluride (HgCdTe) detector, and contain an elaborate reference metrology system utilizing a helium neon (HeNe) laser or stabilized laser diode. These systems require an expensive retroreflector array to return the open path beam. Finally, without an expert spectroscopist to analyze the measured spectra for the compounds present, the instrument is not complete as an air quality monitoring device. We have addressed all of these short comings in our work supported by this SBIR contract.

As part of this effort, we have demonstrated a novel concept for controlling the scanning interferometer mirror and clocking the data acquisition using our NanoScale™ position sensor. We have also demonstrated a novel technique for manufacturing plastic injection molded retroreflector arrays at a small fraction of the cost of traditional retroreflector arrays. We have also worked cooperatively with the Department of Chemistry at the University of Idaho under Dr. Peter Griffiths to implement a set of algorithms based on neural networks and partial least squares (PLS) which automatically detect and quantify an exhaustive list of 105 different compounds from the measured spectra. Our work effort has produced a graphical user interface (GUI) allowing the user a number of functionalities along with the capability of autonomous molecular monitoring.

OP-FTIR Spectrometer Photo

