



# DIAL

**Diagnostic Instrumentation & Analysis Laboratory**  
Mississippi State, MS 39762-5932

## FTIR Capabilities and Applications

### Background

The Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi State University offers technical expertise and field measurement capabilities in the use and application of FTIR spectroscopy for environmental, energy, and commercial process monitoring. The method allows the simultaneous quantification of at least 20 different molecules in as little as one minute and concentrations from as low as one part per billion to as high as 20 percent can be determined. In addition, the FTIR method can be used to determine average gas stream temperatures (273 - 3000 K) and for recovering particle size distributions between 0.2 and 20 microns in diameter. These capabilities invite a number of different applications including:

- process monitoring,
- APCD efficiencies,
- continuous emission monitoring,
- open path (OPFTIR),
- localized process control.

The FTIR method is based on the absorbance or emission of infrared radiation as a molecule undergoes a transition from one vibration-rotation state to another. Analysis follows Beers law,

$$-\ln T_v = a_v = c \cdot l \cdot \sigma_v$$

where  $T$  is the transmission,  $a$  is the absorbance,  $c$  is the concentration,  $l$  is the pathlength and  $\sigma$  is the molecular absorption (calibration) or scattering (Mie theory) coefficient. Every molecule, except homonuclear diatomics, possesses a unique molecular structure and therefore unique vibrational rotational transitions.

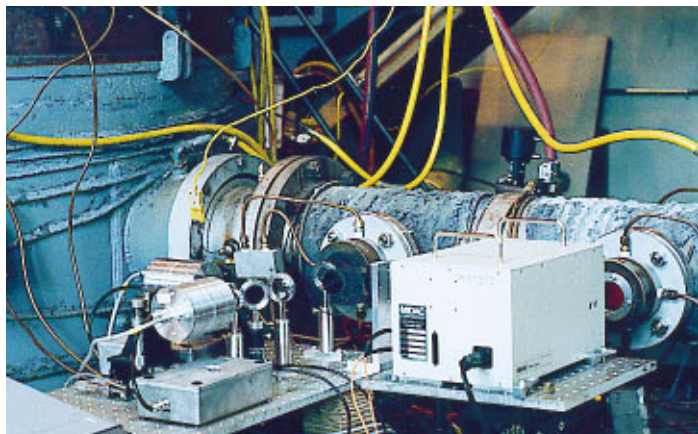
### Applications

The DIAL FTIR systems are versatile and have been used for

- mixed-waste remediation process characterization (radioactive environment),
- APCD efficiencies (catalytic reduction and flameless oxidizer),
- combustion stoichiometry/burner performance,

- particle carry-over from plasma torch units,
- operating envelopes for Joule-heated melters,

Current work is aimed at controlling process components such as feeders, scrubbers, and gas handling systems, based on ir signatures.



*FTIR emission measurements downstream of DIAL's 150 kW plasma torch.*

### Technology Base

The DIAL FTIR laboratory is equipped with three  $0.5 \text{ cm}^{-1}$  interferometers, gas cells ranging in path length from 1 to 107 m, optical port assemblies for on-line measurements, a 20.5 cm telescope and a 50.8 cm source dish for OPFTIR, computers, spectral libraries and simulation software, and over 20 years experience in environmental and energy process diagnostics.

### Availability

The DIAL FTIR technology is available for field applications and system integrations. For further information, contact J. S. Lindner, Ph. D., at:

### DIAL

Post Office Box MM  
Mississippi State, MS 39762-5932  
Phone: (662) 325-2105  
FAX: (662) 325-846  
email: dial@dial.msstate.edu