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Atmospheric Formaldehyde Monitoring in the Greater Houston Area

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- Motivation and Technology Issues
- Infrared Diode Laser-based Gas Sensor
- Formaldehyde Concentration Measurements in the Greater Houston Area
- Summary and Outlook

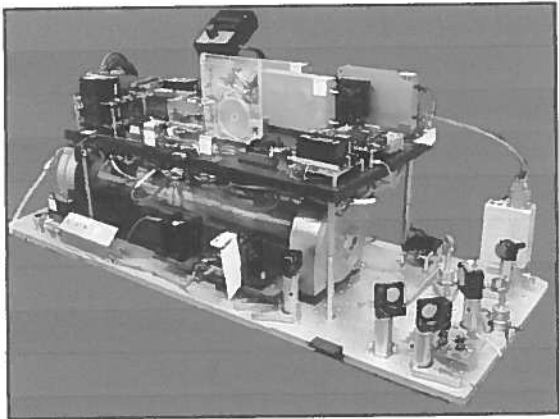
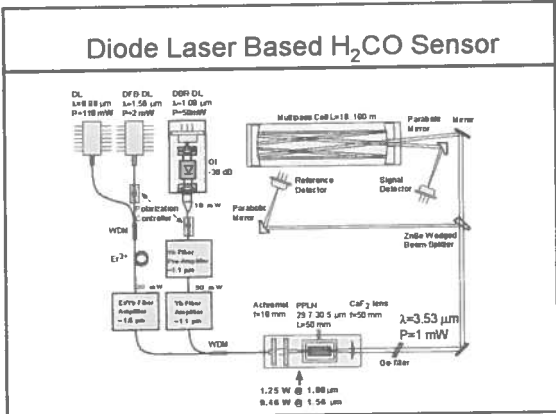
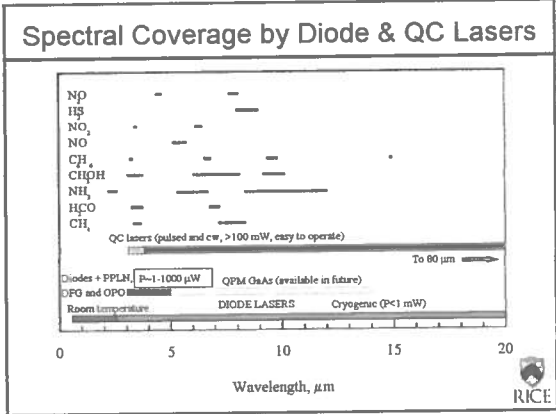
Motivation for Precision Monitoring of H₂CO

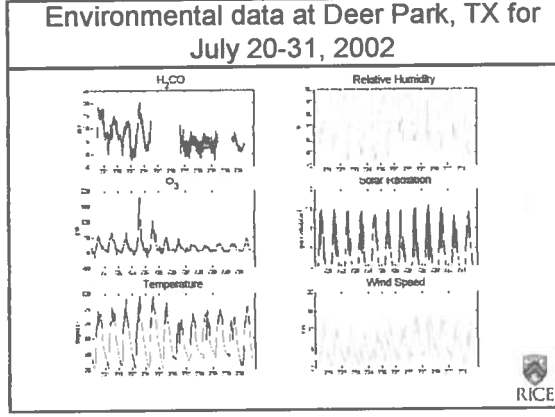
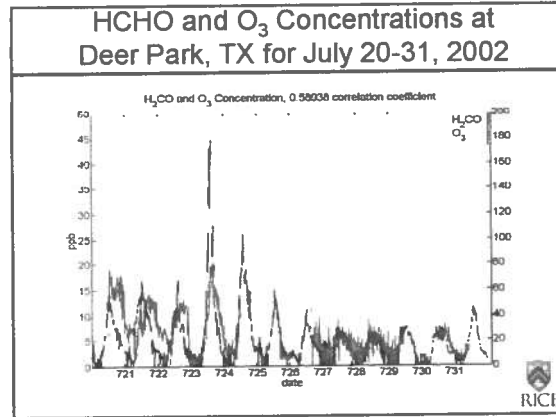
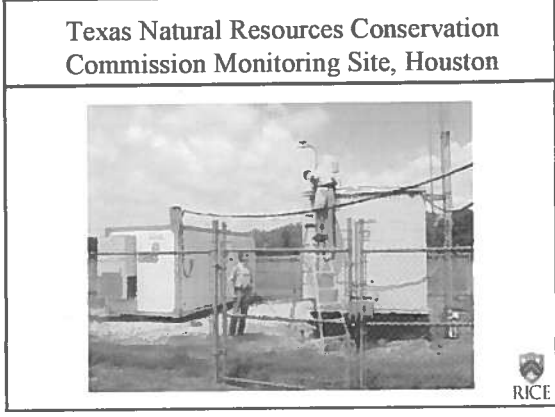
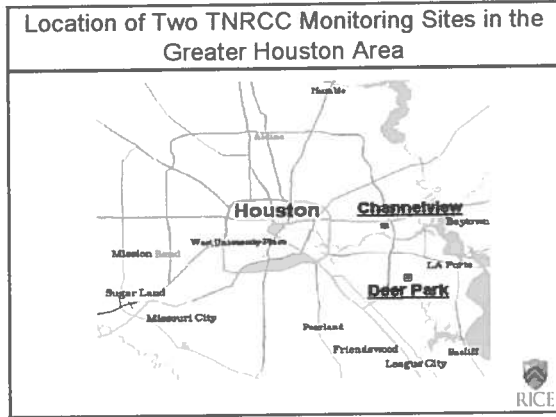
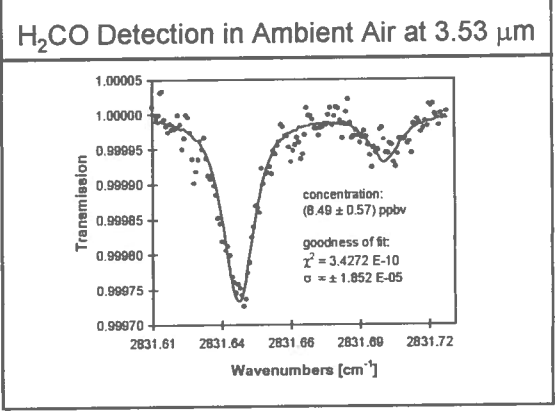
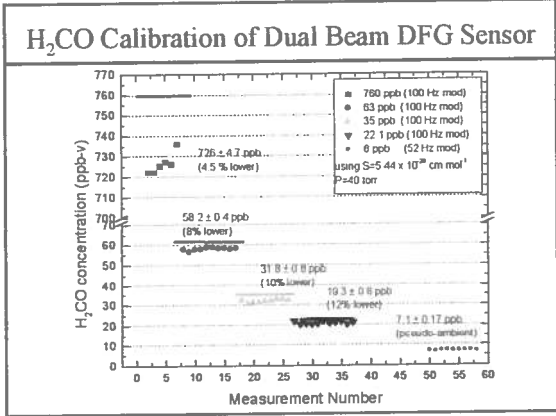
- **Precursor to atmospheric O₃ production**
- Pollutant due to incomplete fuel combustion processes
- Potential trace contaminant in industrial manufacturing products
- Medically important gas

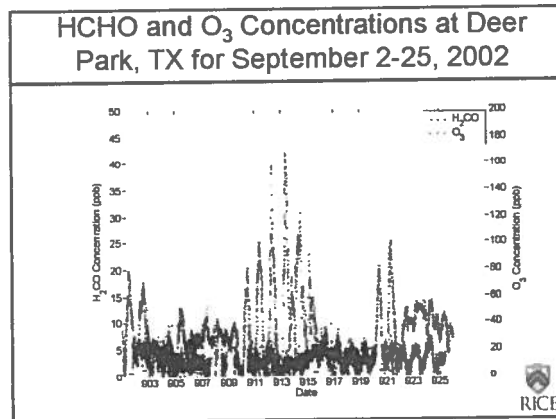
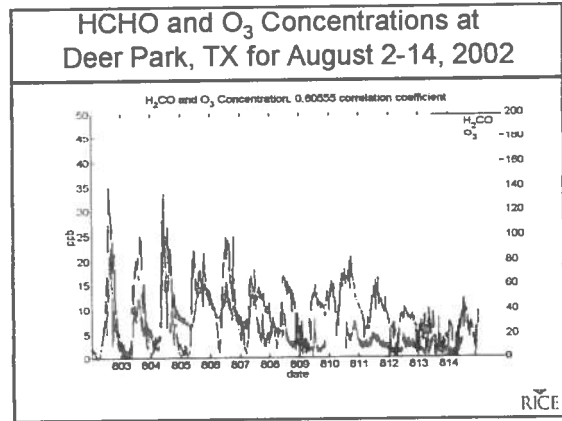
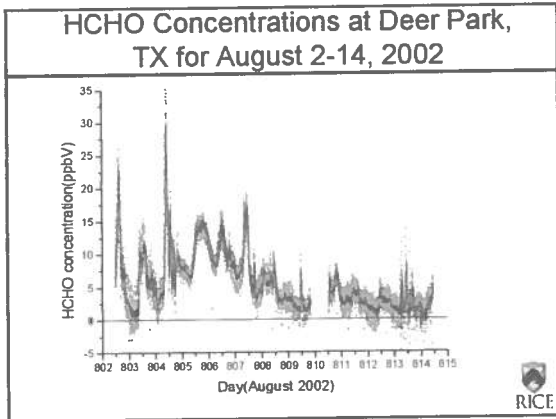
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Design Features of CW DFG based Gas Sensor

- Adequate Mid-infrared DFG Power
- High Sensitivity (ppb concentrations)
- High Selectivity (<30 MHz)
- Wavelength Tunable (Single or Multiple Trace Gases)
- Fast Data Acquisition and Analysis
- Room Temperature
- Non-invasive, Point or Remote Monitoring
- Compact, Lightweight and Robust
- Power Efficient
- No Consumables, Low Maintenance and Cost Effective







Summary

- **Diode Laser Based Trace Gas Sensors**
 - Compact, tunable, robust (alignment insensitive), fieldable
 - High sensitivity ($<2 \cdot 10^{-4}$ to 10^{-5}) and selectivity (10–300 MHz)
 - Fast data acquisition and analysis
 - Detected trace gases: H₂CO, NH₃, CH₄, NO₂, N₂O, H₂O, CO₂, CO, NO, HCl, SO₂, C₂H₅OH, isotopic species of ^{12,13}C, ^{16,17,18}O, ^{35,37}Cl
- **Applications in Trace Gas Detection**
 - Environmental monitoring: H₂CO, CO, CH₄ (EPA, NASA, NCAR, NOAA,)
 - Industrial process control and chemical analysis
 - Medical diagnostics (NO, CO, CO₂, NH₃)
- **Future Directions**
 - Fiber lasers and amplifiers
 - Longer mid-IR wavelengths with orientation patterned GaAs and QCL lasers, detection of complex molecules

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