MetroLaser, Inc.

Sensors for Manufacturing Efficiency Workshop

DOE Sensors & Automation
2005 Annual Portfolio Review

A Versatile Diode Laser Absorption Sensor for Temperature and Species in Industrial Environments

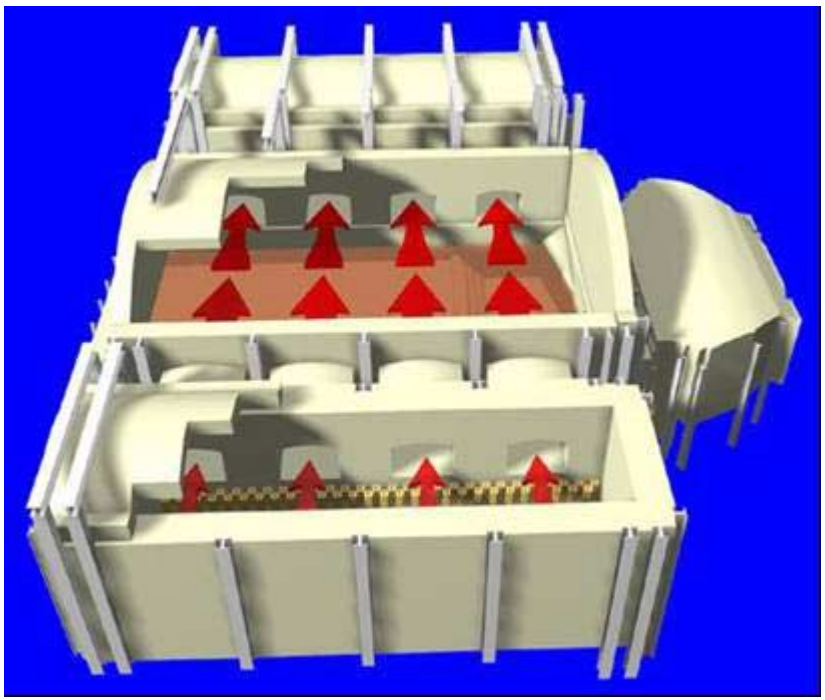
T. P. Jenkins - MetroLaser, Inc.

J. L. Bergmans – Bergmans Mechatronics LLC

Project Description

- Need
- Goal
- Core Technology
- Novel/Transformational Elements
- Initial Industry for Application
- Key Project Deliverables

Glass Industry Needs Improved Efficiency



Cross-fired regenerative glass furnace*

***Figure from www.hornglass.de**

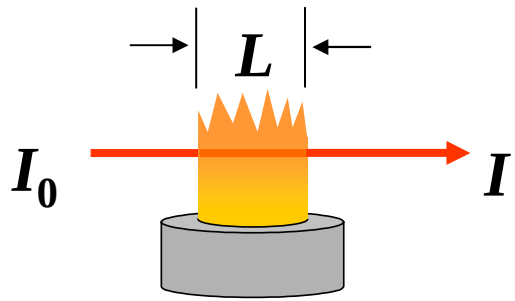
- Energy used = 2 x theoretical
- Rising energy costs
- Vision calls for reduced emissions

Goal

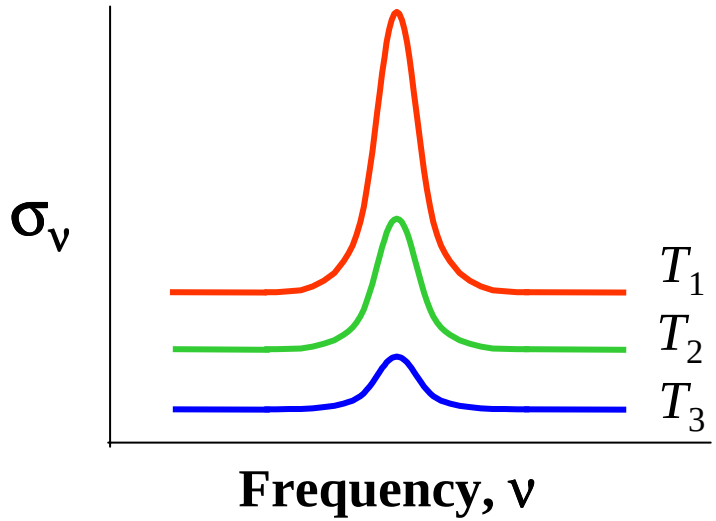
Develop and demonstrate a temperature and species sensor that will help the glass industry to:

- Reduce production costs to 20% below 1995 levels
- Reduce process energy use from present facility levels by 50%
- Reduce of emissions by > 20%
- Improve quality by improved consistency of operation

Tunable Diode Laser Absorption Spectroscopy

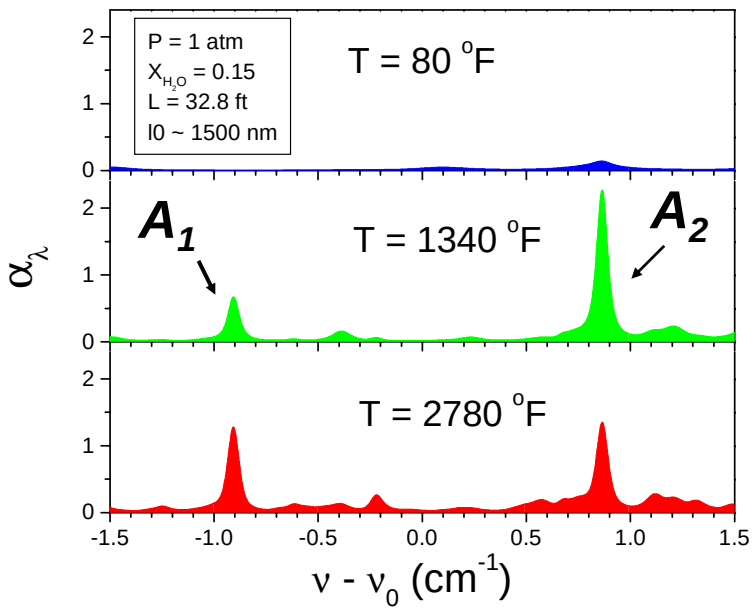


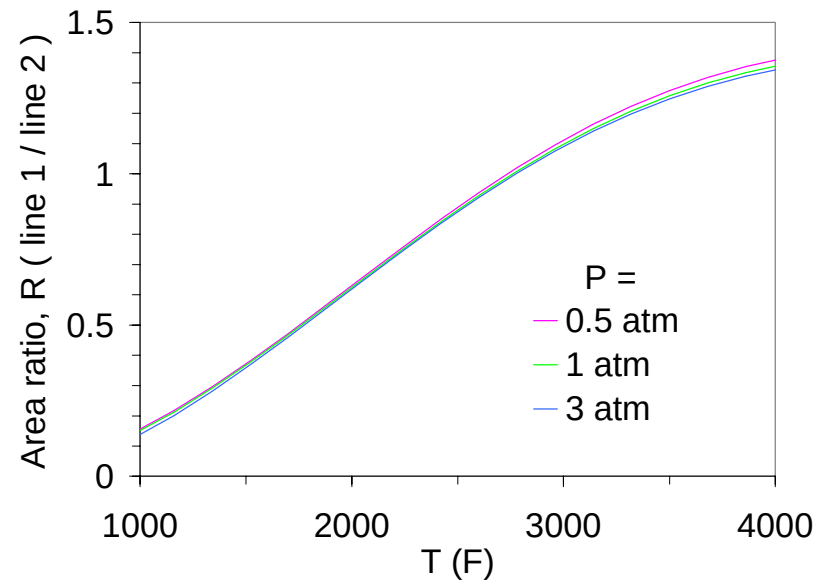
$$\frac{I}{I_0} = \exp\left(-n\sigma_\nu L\right)$$



- Absorption over path L is measured
- Laser is scanned over a molecular absorption line

Tunable Diode Laser Absorption Spectroscopy





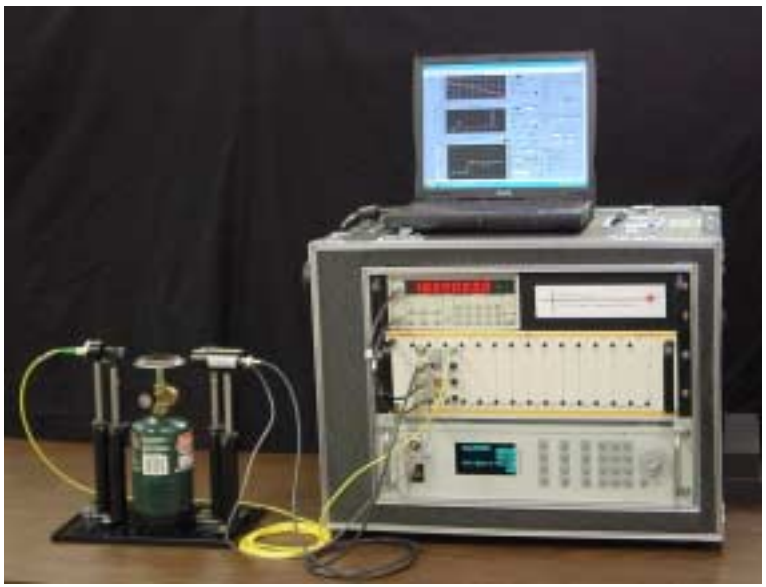
- Spectral areas vary with *T*, X_{H2O}, *& P*
- Ratio A_1/A_2 varies only with T
- Once *T* is obtained, A_1 or A_2 yields H_2O *concentration*
- *Measurement is insensitive to ambient* H_2O

Current Technology fails at High Temperatures

Thermocouple breaking at high temperature

- Furnace exhaust temperatures exceed thermocouple limits
- Diode laser sensor easily measures these temperatures

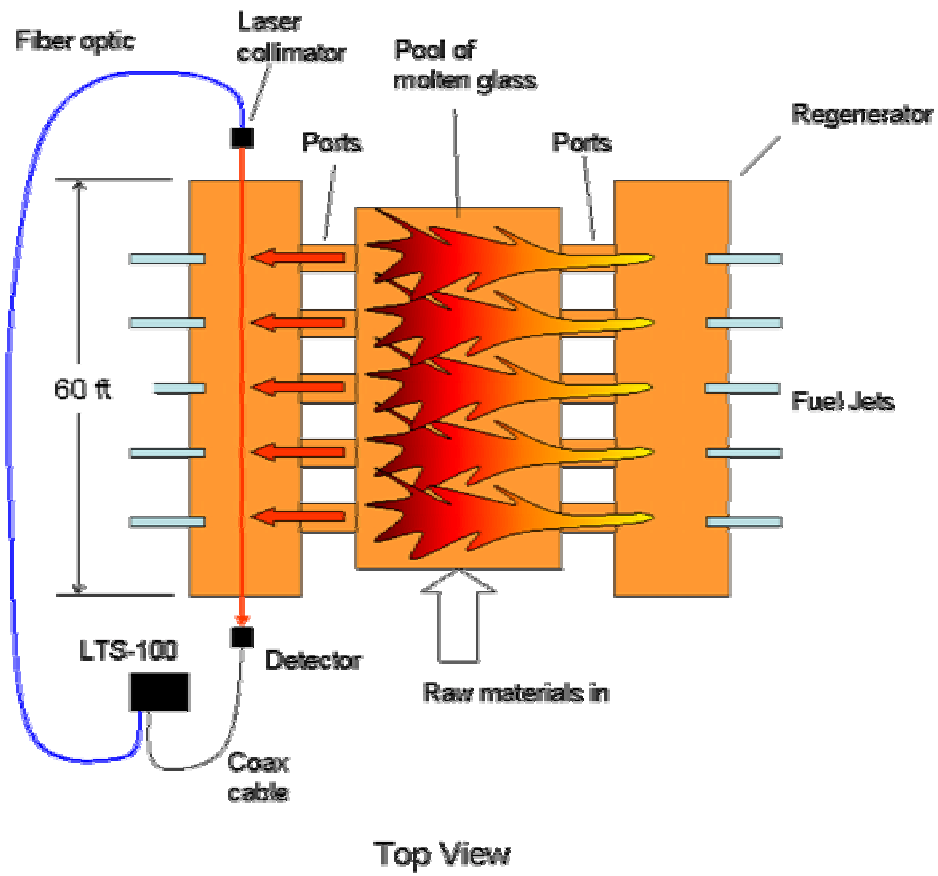
Project Deliverables



MetroLaser LTS-100

- Quarterly progress reports covering the development of a prototype sensor
- Final report documenting the key findings
- Demonstration in a glass furnace

Barriers and Pathways



Challenges

- 60-foot path through furnace
- High ambient temperature
- Limited space available

Solutions

- Beam alignment sight
- OTS components
- Small footprint

Demonstration Experiments

Beam launch

Beam catch

Performed at a float glass plant in California

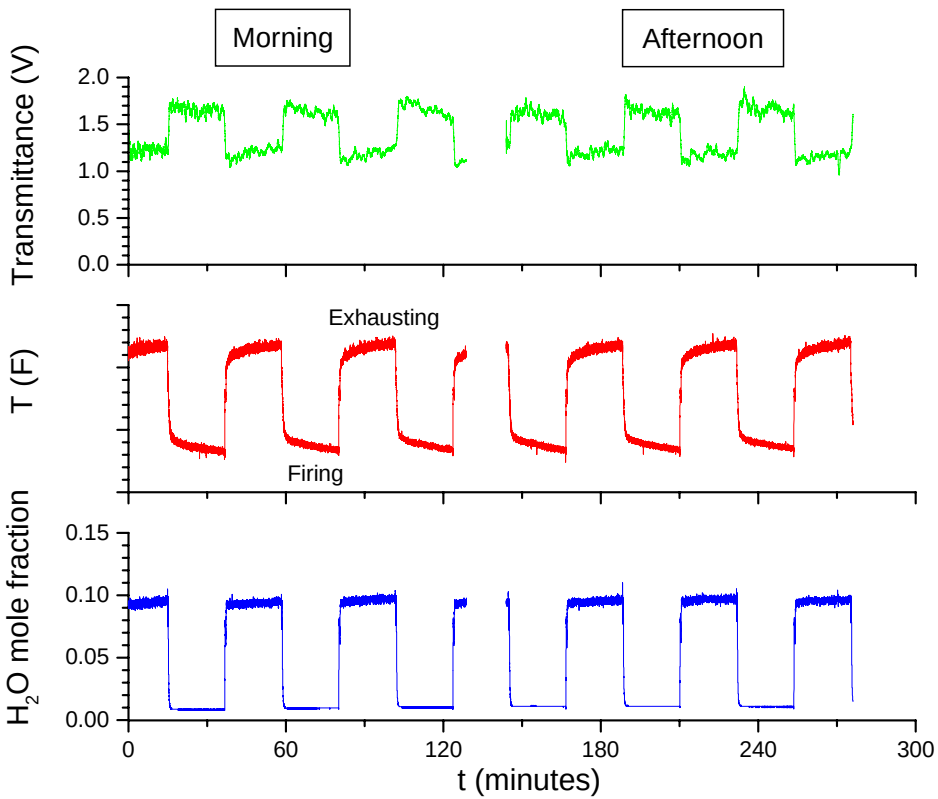
Energy Savings

- Energy saved by improving efficiency and reducing losses
- Assumption: a successful control algorithm can be developed that uses the sensor
- Process improvements could account for savings ~ $1,000,000/yr for a single glass plant

Other Important Metrics

- The sensor may provide particulate concentration measurements that may help the industry to control fouling of the exhaust passages.

Accomplishments to Date



- Successful measurements in a glass furnace.
- Signal/noise ratio exceptionally good.
- Measured values consistent with expected results.
- Results might be used for timing furnace cycles

Anticipated Economic Impact

- Energy savings due to higher efficiency industry wide.
- Improved product quality.
- Reduction in pollutant emission will result from decreased fuel consumption.

Continuation after ITP-Sponsored Project

- Finish testing the LTS-100 for compliance with UL and CE requirements for safety.
- Obtain a CE certification for the LTS-100 for commercial markets in the US and worldwide.
- Continue development work on probe/furnace interfaces.
- Explore other markets: pharmaceuticals, food production

Value Proposition for End User

- Estimated annual savings of $1,000,000 in fuel and maintenance costs due to improved efficiency.
- Reduction in defective product due to improved consistency of furnace operation.

Commercialization Plan

- Fall 2005 - Sale of at least one LTS-100 to a glass producer.
- Winter 2006 - Demonstration of actual cost savings by using the LTS-100 in a glass manufacturing plant.
- 2006 and beyond - Additional sales of LTS-100 systems to this and other glass manufacturers.

Commercial/Technical Risks Remaining

- Risk: An active control system that can use this sensor may not be developed.
- Solution: The potential cost savings should be great enough to trigger development of such a control system. One company has already expressed their intent to develop technology that uses this sensor in order to achieve cost savings

Showcasing Opportunities

- Float glass plant
- Pharmaceutical manufacturing
- Food manufacturing