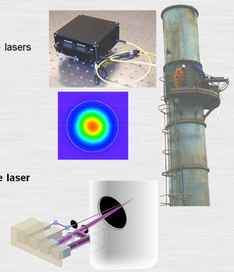
Advanced Research Program
Technology Goal Statements

Technology Project Goals

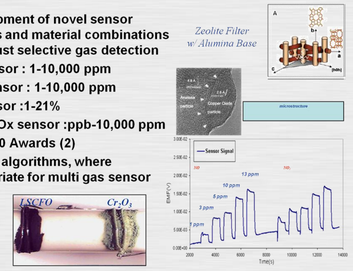
Sandia National Laboratory
Speciating Mercury Emissions Monitor

- **New Light Sources**
  - Compact, rugged, light weight
  - Pumped with reliable, low-cost diode lasers operating at room temperature
  - Narrow linewidth
  - Insensitive to:
    - Temperature
    - Mechanical fluctuations
    - Optical power level
    - Aging of laser system
- **Detection of $HgCl_2$ by photofragment emission**
- **Detection of Atomic Hg by Resonance laser induced fluorescence**
  - Demonstrated ability to perform fast optical switching
  - Produced Q-switched output from a fiber laser



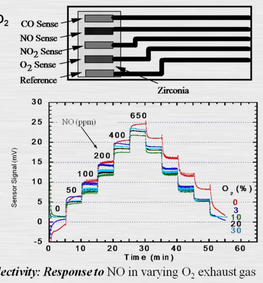
Ohio State University
Harsh Environment Orthogonal Sensors

- **Development of novel sensor designs and material combinations for robust selective gas detection**
- **CO sensor : 1-10,000 ppm**
- **CO_2 sensor : 1-10,000 ppm**
- **O2 sensor :1-21%**
- **Total NOx sensor :ppb-10,000 ppm**
- **R&D 100 Awards (2)**
- **Utilizes algorithms, where appropriate for multi gas sensor arrays**



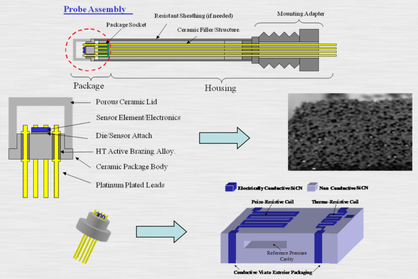
Solid State Micro Sensor Arrays

- **Multifunctional $NO/NO_2/CO/O_2$ solid-state sensors**
  - based on conventional automotive sensor technology
- **Fundamental sensing mechanism based on catalytic/material properties**
- **Demonstrated 1 ppm resolution (e.g. CO) and *selective* detection**
- **Commercializing technology**
  - Licensed technology
  - Developing prototypes



Selectivity: Response to NO in varying O_2 exhaust gas

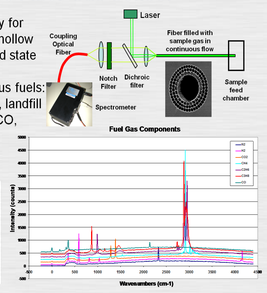
Integrated Micro Sensor
(Temperature and Pressure)



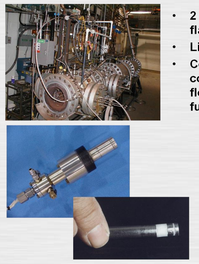
Hollow Core Fiber Gas Sensor

- Raman based spectroscopy for mixed gas detection using hollow core fiber and compact solid state laser
- Universal sensor for gaseous fuels: NG, coal syn gas, biomass, landfill
- Gases include N_2, O_2, H_2, CO, CO_2, C_1-C_3, H_2O
- Fast response (<1 sec)
- NETL, WVU, UPittsburgh

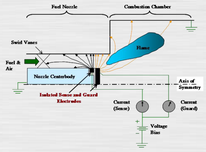
CalGas Sample Determination		
Experimental %		Quoted
45.56	N2	43.82
0.68	O2	0
14.80	CO	15.75
14.75	CO2	15.64
5.17	CH4	5.19
3.15	C2H6	3.13
-0.0002	C3H8	0
15.91	H2	16.47



Combustion Control and Diagnostics Sensor (CCADS)



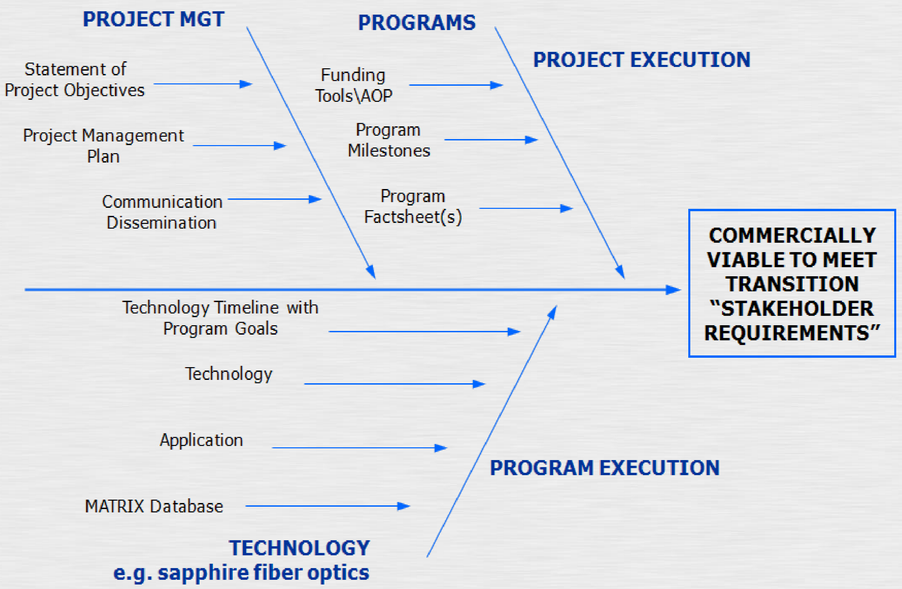
- **2 Electrode sensing system to detect flashback, LBO, and dynamics**
- **Licensed to WOODWARD**
- **Continuing research in monitoring combustion dynamics, use in local fuel flow control, & use in high hydrogen fueled turbines**



Technology Requirements Traceability

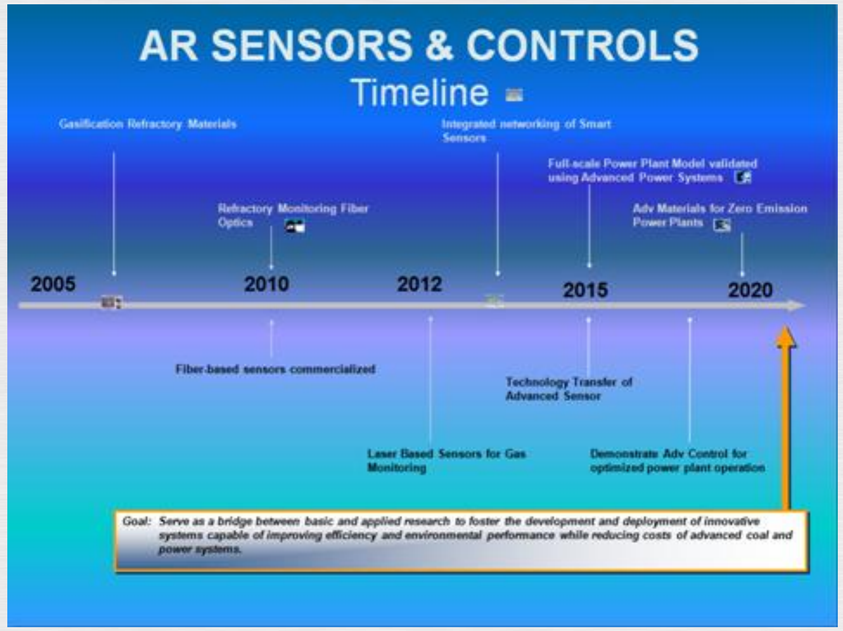
Sensor:FiberOptic:Temperature Technology Development Design Parameters	Temperature	Temperature	Accuracy	Response Time	Drift	Pressure	Chemical	Pressure	Chemical	How Measured	Goals & Thresholds
	System/Subsystem Application: Design Variables										
Temperature Range											LTL 50 °C, UTL 800 °C
FOAK and Startup											UTL 800 °C
Continuous Operations											600 °C
Response Time											LTL < 5 seconds (90% step response)
Accuracy											+/- 2.5 °C
Drift											< +/- 2.5 °C
Pressure											Undefined
Environment											Undefined
	Fireside	Metal				Fireside	Fireside	Steamside	Steamside		Design Set Points
	UTL = 1500 °C	UTL = 800 °C	UTL = 2.5 °C	Undefined	Undefined	UTL = 1 bar	Reducing environment with variable levels of fuel-based sulfur-oxides	UTL = 300 bar	pH 7-9 Iron hydroxide Dissolved oxygen 0 - 100 ppb		Ranges/Tolerances

Technology Road Map (Summary Chart)
AR Sensors and Controls



Assessing gap analysis will address system application needs and technology development goals

Planning for programs and projects will lay out the timelines and roadmaps for future research



AR Project Goals Tailored to System Application Needs

Advanced Research