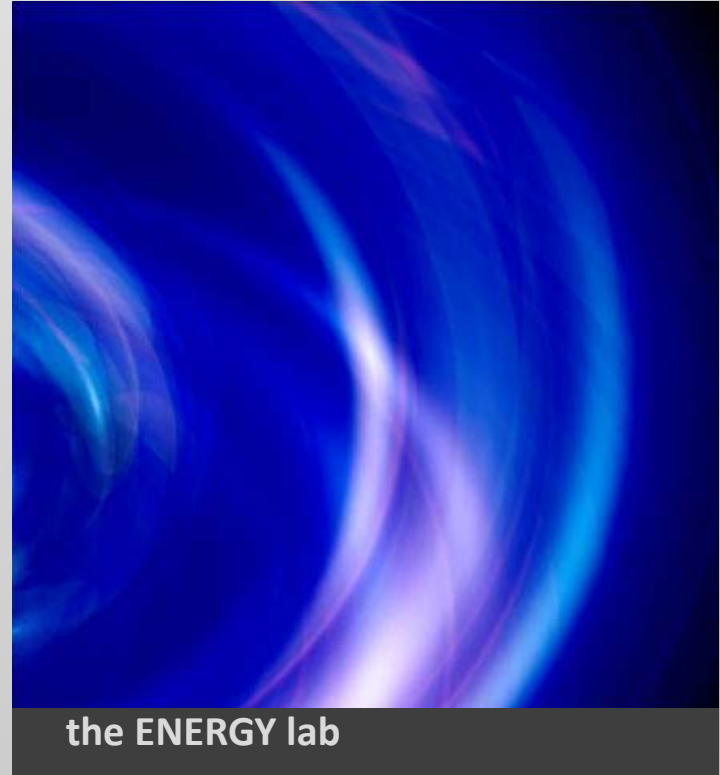




## Improved Laser Induced Breakdown Spectroscopy (LIBS) Elemental Composition Detection System

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U.S. DEPARTMENT OF

**ENERGY**

National Energy  
Technology Laboratory

# The Need

Sensors are increasingly needed to continuously measure:

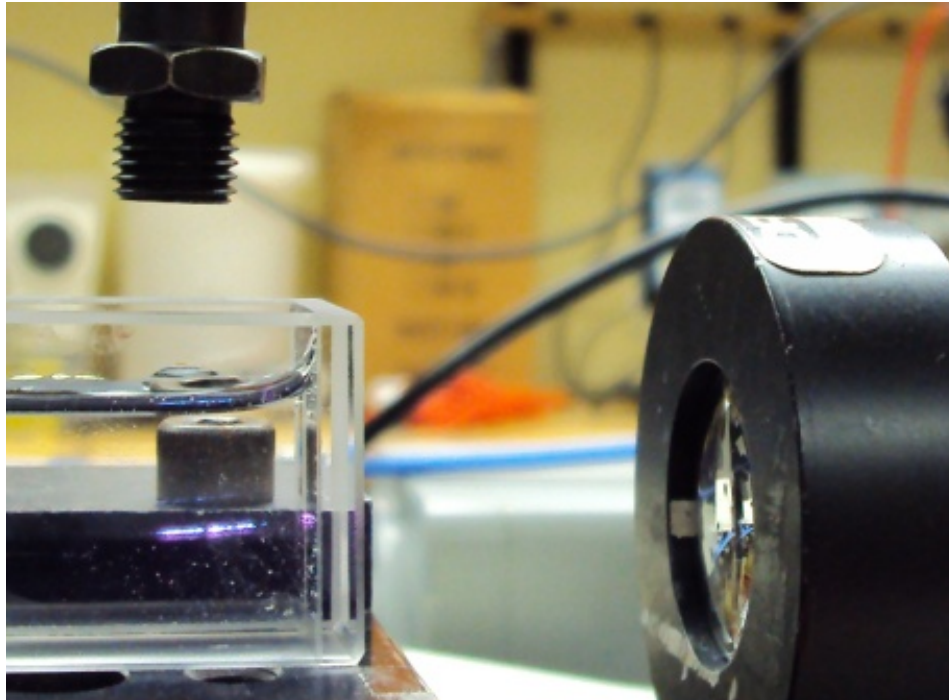
- **Ground water quality**
  - Pollutants in fresh and salt water systems
- **Air quality, both indoors and outdoors**
- **Gas composition**
  - Natural gas, volcanic gas, landfill gas, shale gas, flue gas
- **Soil composition**

These measurements are important to oil and gas exploration companies, landowners, regulatory agencies, and municipalities, and any organization monitoring emissions.



# The Problem

- Current sampling and analysis is labor intensive and significantly changes the sample by cooling and depressurizing.
- Current analysis technology is not amenable for harsh environments.



# The Solution

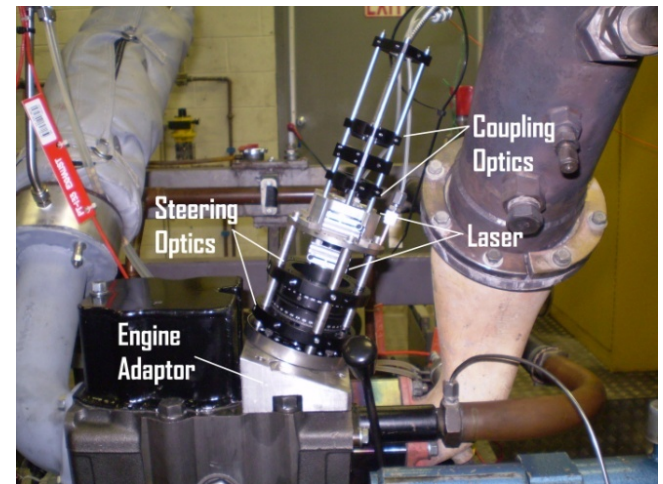
A device to measure subsurface gases, liquids, and solids at subsurface conditions, with:

- Continuous monitoring of an extreme environment
- No sample collection
- No sample preparation
- Easy to use
- Low cost (compared to competitors)
- High data quality
- The ability to see changes in down hole fluid chemistry before and after injection and/or fracturing



# The Technology

- Atomic identification and concentration measurements can be made on solids, liquids, and gases at down hole pressure and temperature conditions
- Technology was developed at NETL as part of the DOE Sensors and Carbon Storage program
- Development Stage:
  - Proof of concept experimentation completed
  - Prototype and system design and development underway
- Two U.S. Nonprovisional Patent Applications have been filed



# The Competition

- **Gas Chromatography-Mass Spectrometry**
  - Gas phase only, Lab operations and conditions only
- **Inductively Coupled Plasma-Mass Spectrometry**
  - High degree of sample prep, Lab operations and conditions only
- **High Pressure Liquid Chromatography**
  - Liquid phase only, Lab operations and conditions only
- **Cavity Ring Down Spectroscopy**
  - Gas phase only, few ruggedized models available
- **Portable Raman**
  - Solids only, few ruggedized models available

# The Technology Summary

- **Summary**

- Down hole contaminant monitoring
  - Atomic identification and concentration measurements can be made on solids, in liquids and gases at down hole P/T conditions
- Market
  - Regulators, Exploration Companies, Municipalities, Land owners
- Development Stage
  - Laboratory Investigations
  - Prototype design phase

- **Funding**

- Source of funding – DOE as part of the Sensors & Carbon Storage Program

- **Strength of the team**

- Optical measurement and laser design experts Dr.s Woodruff and McIntyre USDOE
- Geochemistry Expert Dr. Jinesh Jain

# Partnership Opportunity

**This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.**

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