Fiber Optic Sensors for Harsh Environments

Jon Greene
Lambda Instruments, Inc.
Blacksburg, Virginia
jgreene@lambdainc.com

RCC 21st Transducer Workshop

June 23, 2004

Outline of Presentation

- Introduction to Lambda Instruments, Inc.
- Fiber optic sensors at Lambda
  - Strain/displacement
  - Pressure
  - Humidity

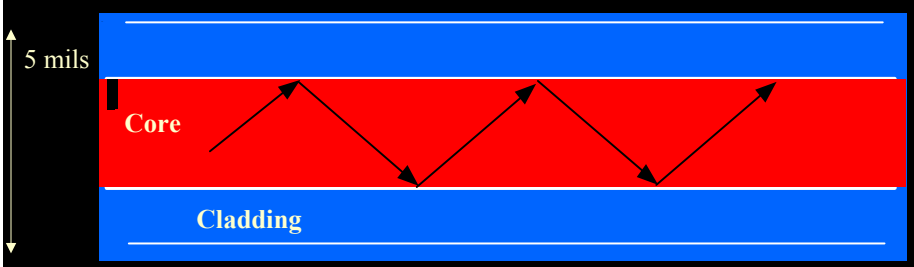
Who We Are

- Fiber optic sensor R&D engineering firm
- Located in Blacksburg, VA - "Silica Valley"
- Founded April 1999
  - 4 f/t employees and 4 p/t employees and consultants
- 700 sq. ft. office/lab space, 1,600 s.f. lab space
  - Access to 10,000+ sq. ft. of university lab space
- Background and interest in fiber optic components and sensor system development

Laboratory - Blacksburg, VA

- Class 1000 clean room
- 20 watt argon-ion laser
- Machine shop
- Wet chemistry fume hood

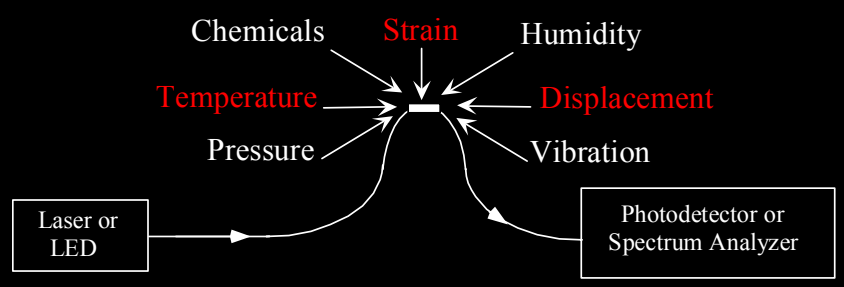
What is Fiber Optics?



Fiber Sensor Advantages

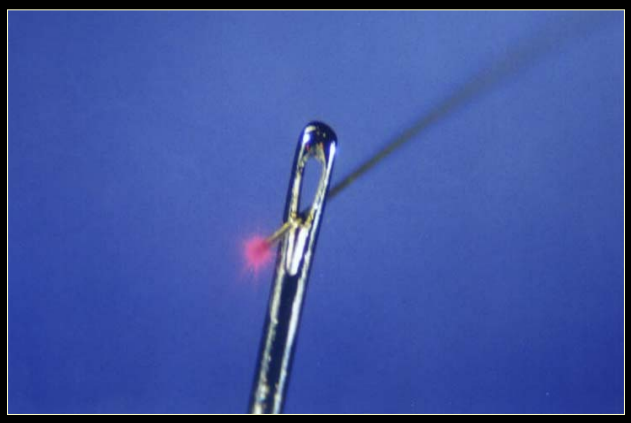
- All dielectric – no spark potential in explosive environments
- Small, lightweight, flexible
- Can be used up to 3000 ºF
- Immunity to electromagnetic interference
- Extremely low thermal-apparent strain

Fiber Optic Sensors



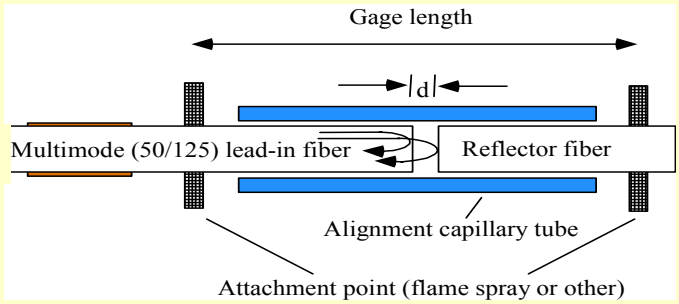
Lambda Instruments, Inc.

VERY Small!



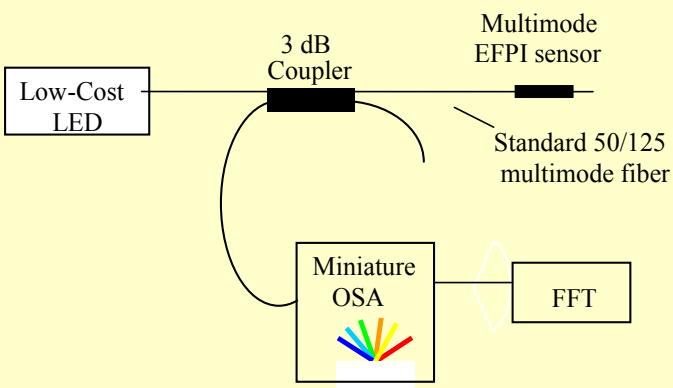
Lambda Instruments, Inc.

Fiber Optic Strain Gage



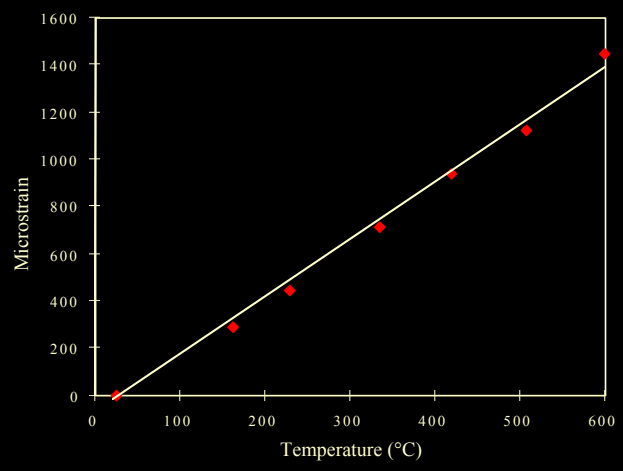
Lambda Instruments, Inc.

Fiber Optic Strain Sensor System



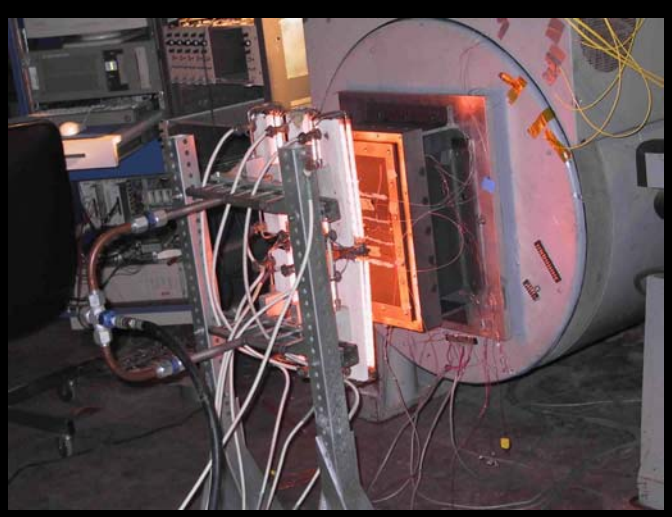
Lambda Instruments, Inc.

Thermal Apparent Strain of CMC



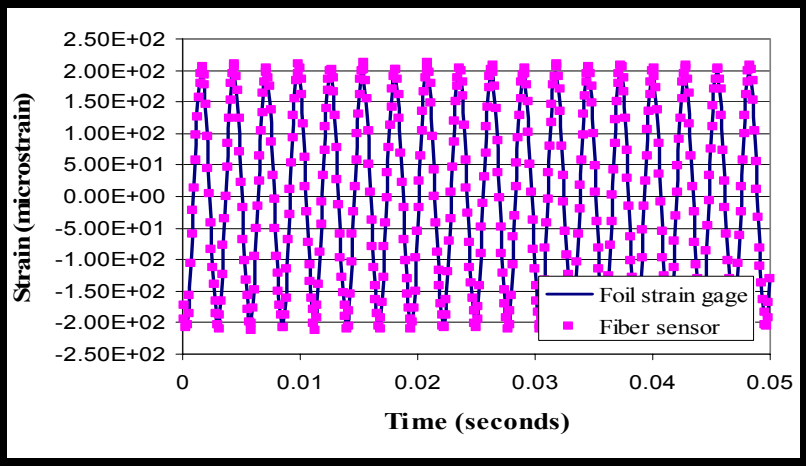
Lambda Instruments, Inc.

CMC Structural Fatigue Testing at WPAFB



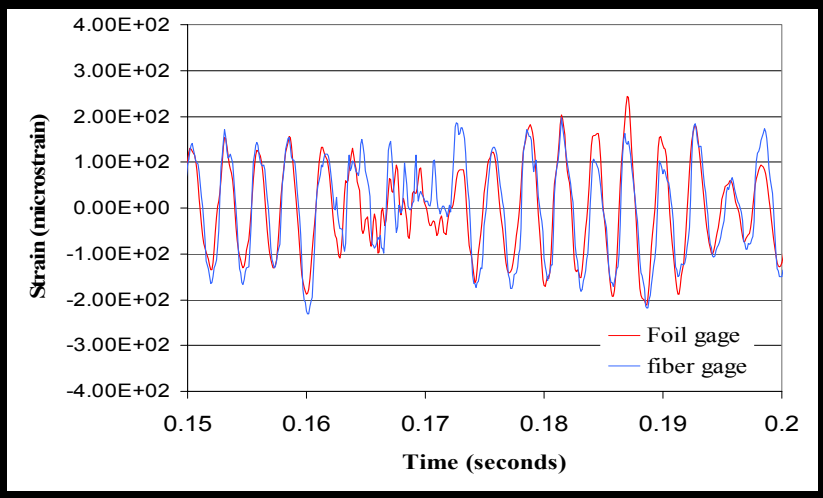
Lambda Instruments, Inc.

Fiber vs. Foil: Sine Excitation



Lambda Instruments, Inc.

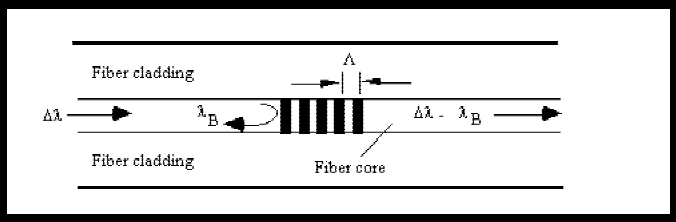
Fiber vs. Foil: Random Excitation



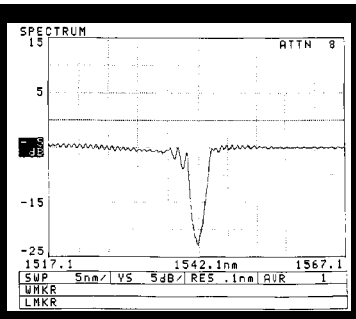
Lambda Instruments, Inc.

Fiber Optic Temperature Sensor

Fiber Bragg grating (FBG)

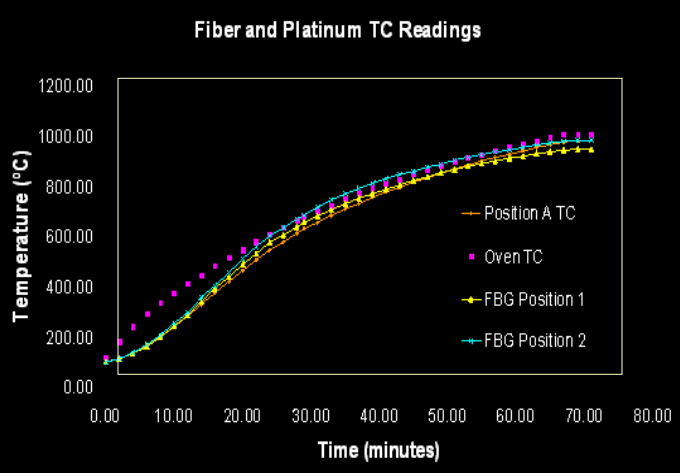


Bragg grating spectrum



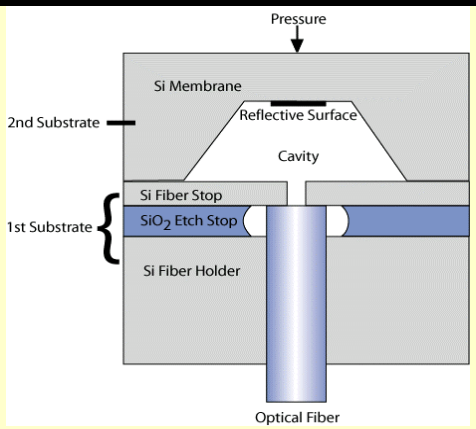
Lambda Instruments, Inc.

Fiber Optic vs Platinum TCs

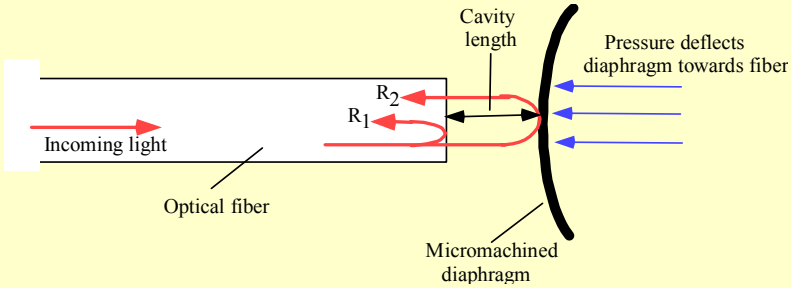


Lambda Instruments, Inc.

Fiber Optic Pressure Sensor



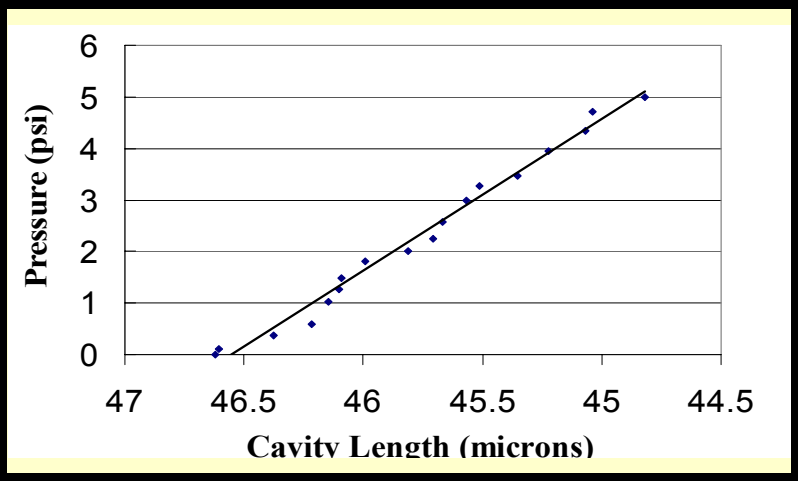
Fiber Optic Pressure Sensor



Fiber Optic Pressure Sensor

Lambda Instruments, Inc.

Fiber Optic Pressure Sensor



Lambda Instruments, Inc.

New at Lambda: Fiber Optic Humidity Sensor

Sensor Systems and GUI

User-friendly software
(Labview)

Optoelectronic support systems

Summary

- Benefits of fiber-optic sensors for harsh environments
  - Small, lightweight, contact measurements
  - No electromagnetic interference
  - No spark hazard
  - Negligible thermal apparent strain
  - Will survive up to 3000°F

Funding Acknowledgements

WPAFB Structural Dynamics Group

NASA Dryden FRC