Advanced Technology Showcase 2009

High Temperature Sensors

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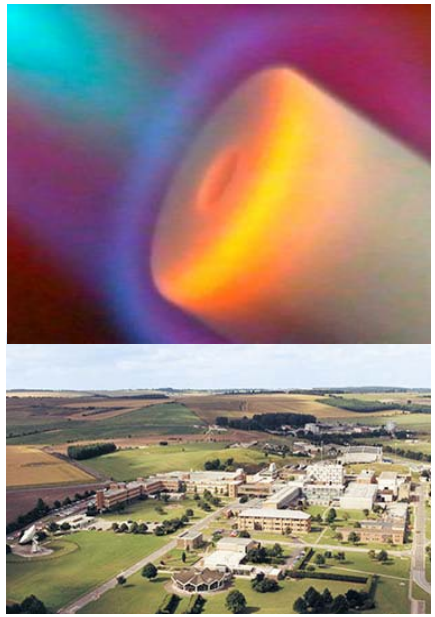
Agenda

- **Oxsensis company background**
- **The Sensor and how it functions**
- **Pressure Sensing Applications**
- **Temperature Sensing Applications**

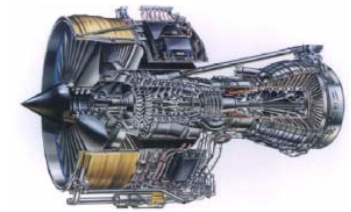
Oxsensis Background

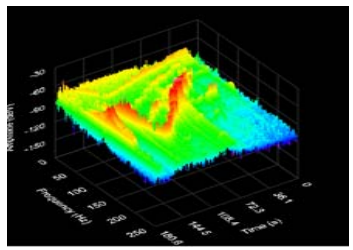
- UK national laboratory heritage - 2003 spin-in / spin-out of STFC Rutherford Appleton Laboratory
- Second generation start-up with fibre optics background, telecoms & aerospace experience
- Based on Harwell Science and Innovation campus
- £4.3m funding round July 2007
- Establishing production in 2008
- Total Staff 26
- US presence, Raleigh NC



Active in 4 Market Sectors

- Power generation:
  - Emissions reduction via optimisation of combustion / NOx avoidance
  - Health monitoring for improved lifetime
  - Nuclear
- Aero Engines:
  - Towards major efficiency improvement in aero-engines
- Aerospace:
  - Braking and hydraulic systems
  - Optical sub-systems for avionics
- Automotive:
  - Combustion cycle improvement





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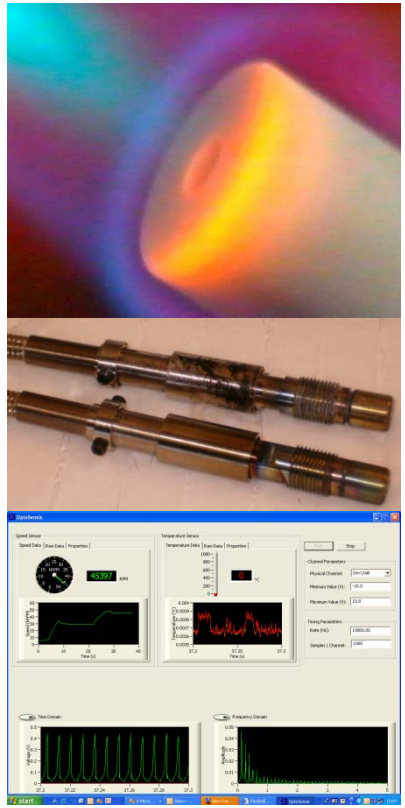
1000C+ Sensors offer future Combustion Management platform

- New Platform with >300C headroom over conventional sensors:
  - Conventional limited to ~700C
  - “Future Platform” for many needs
- Greatly simplified measurements:
  - No water cooling, EMI, vibration effects
  - Develop capability for **3** sensors in **1**
    - Static and Dynamic Pressure, and single point Pressure / Temperature
- Under development with major OEM’s
- Potential disruptive technology for automotive



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Sapphire Fibre Optic Sensors

- **Maximum operating temperatures >1000°C**
- **Frequency response from DC to >50kHz**
- **Dynamic range of 100,000**
- **Full scale static pressure to >50 bar**
- **Resolution set by dynamic range and full scale static pressure**
- **Low vibration sensitivity**
- **EMI immune**

Wave-Phire™ DPT1270 dynamic pressure sensor

Wave-Phire™ DPT950 dynamic pressure sensor

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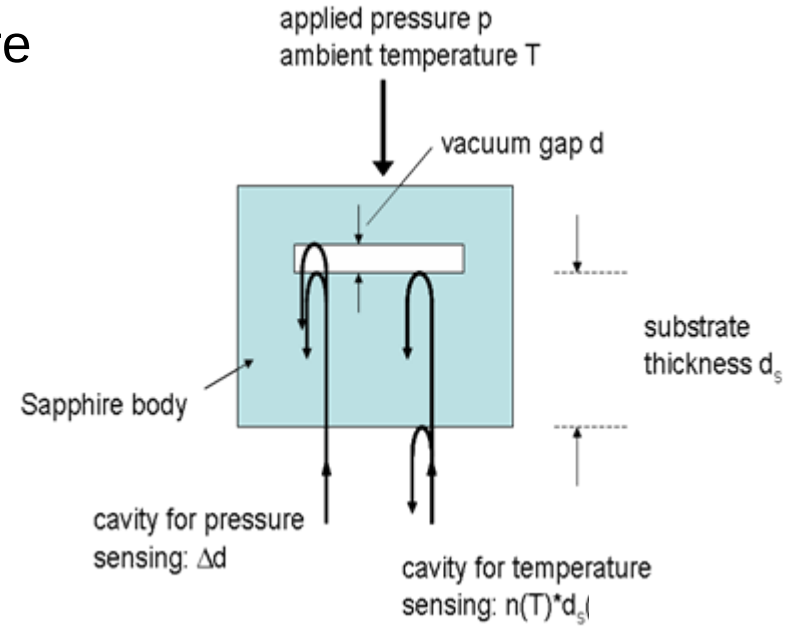
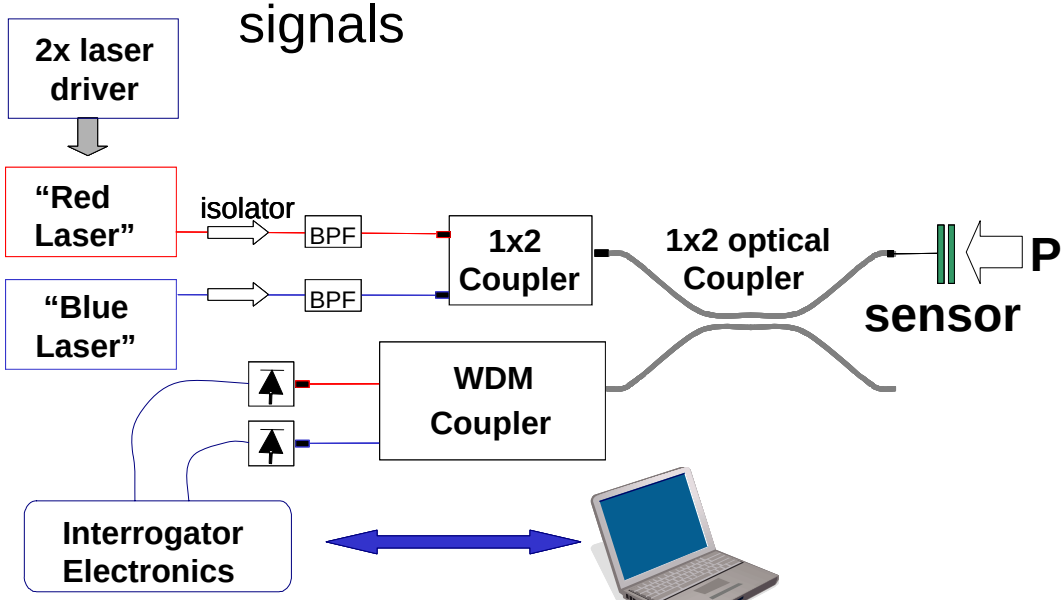
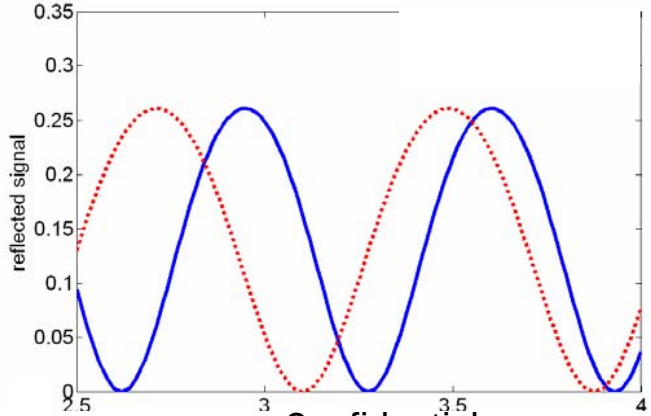
Operation of Optical Pressure Sensors

- Sensor head – single crystal sapphire
- Two wavelengths used to enable robust measurement
- Independent of intensity fluctuations
- Measurement of static and dynamic signals







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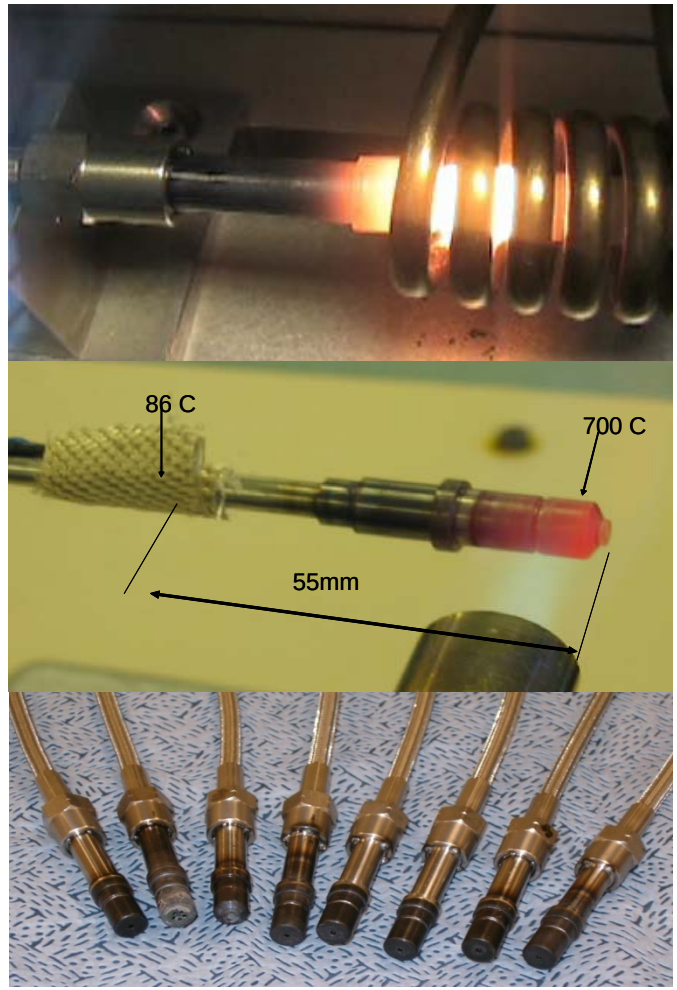
Extreme temperature endurance

- Expansion matched, high temperature packaging
- High temperature steels / welding
- Multiple trials at customer sites
- Direct propane torch to heating to 1000°C
- RF (500 Watt) heating of sensor body to >1200°C while operating as functioning pressure sensor



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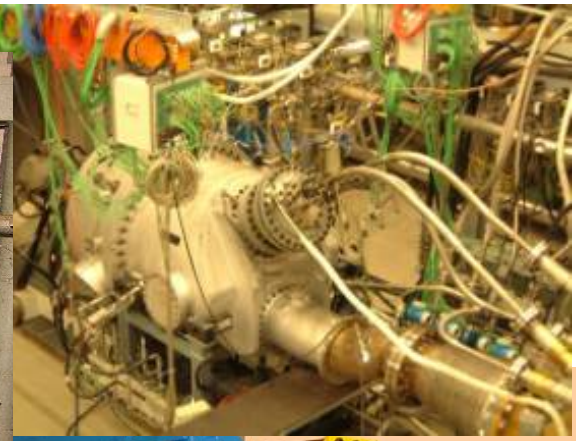
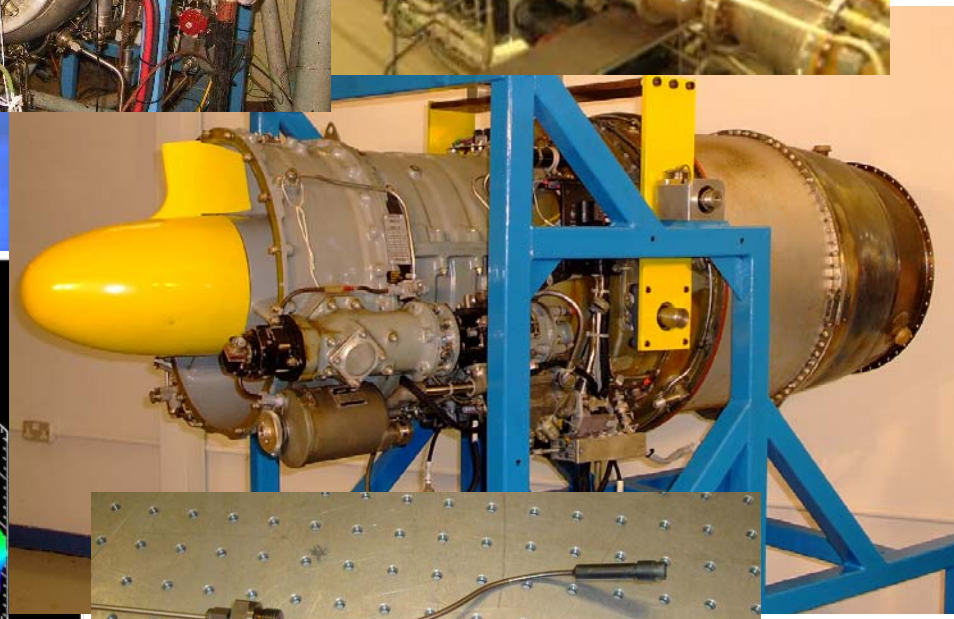
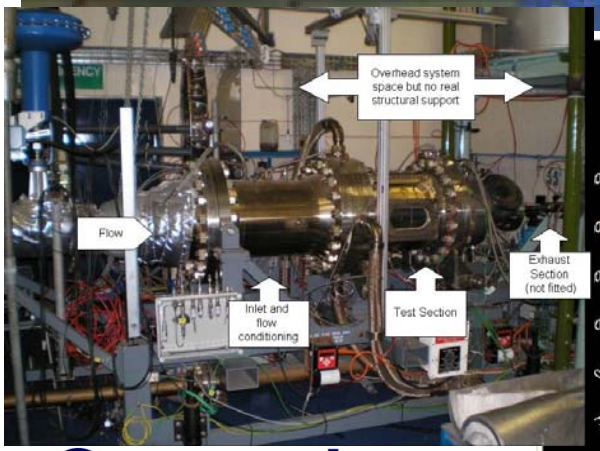
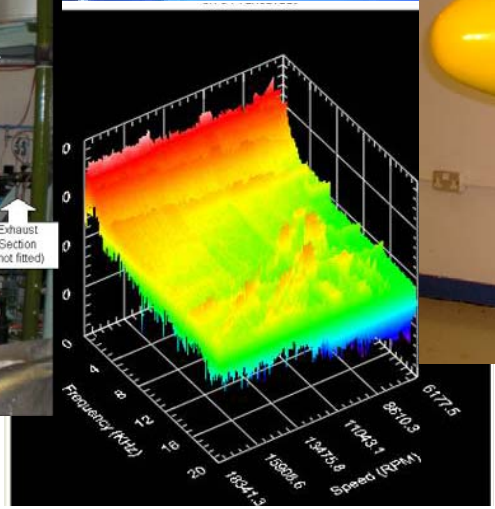
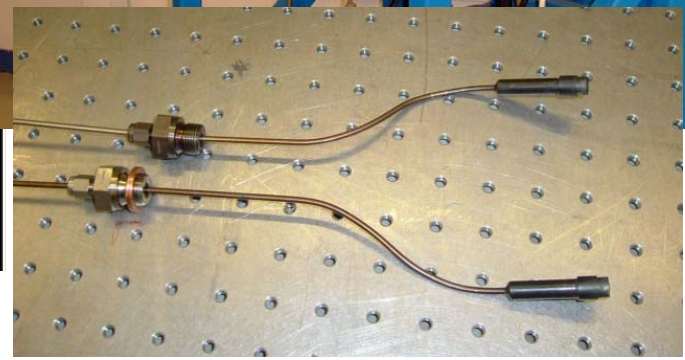
External Demos and Trials











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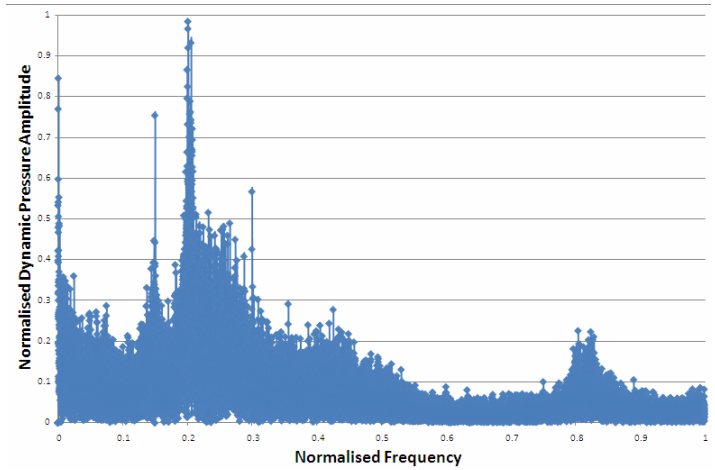
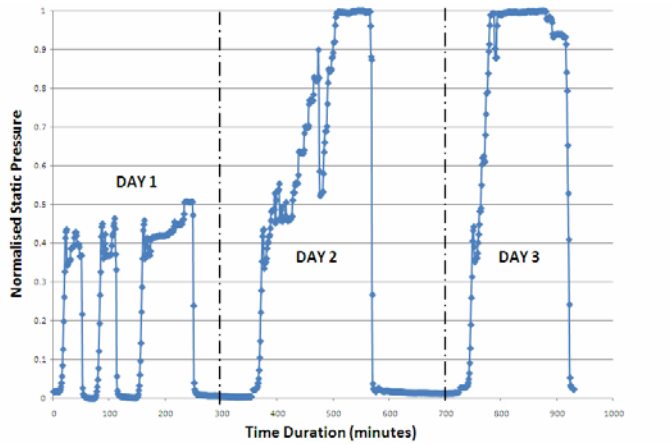
Trial in 200MW Gas Turbine



- Sensor successfully operated for:
  - •Multiple engine starts
  - •Various running conditions
- Successful acquisition of both static and dynamic pressure data



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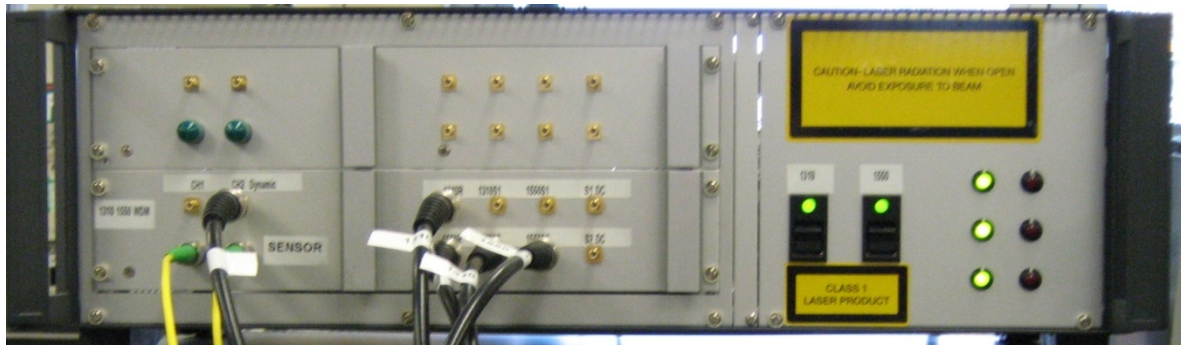
Dual Wavelength Interrogator (DWI)

Oxsensis built Prototype 4 channel system

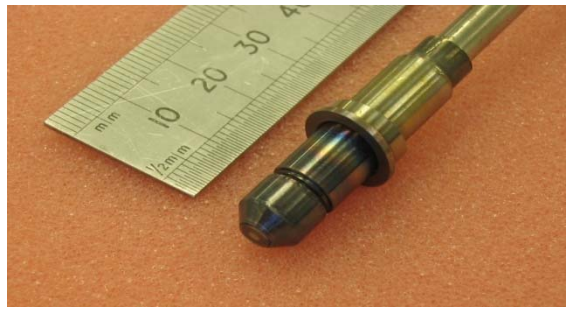


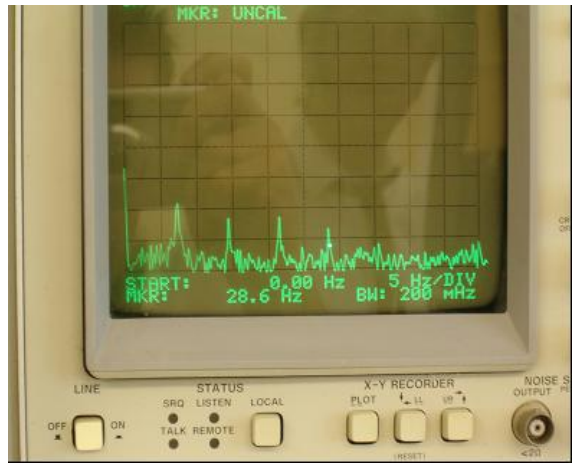
Single channel CE marked units now available

- Compact
- Single Electronic pressure output
- Transparent calibration procedure
- Diagnostic LEDs to indicate interrogator, sensor or cable fault
- Variable gain control DIL switch to boost signal levels

New Direction -Temperature Sensor

- Membrane version similar to Pressure Sensor
- Packaged to withstand >1000C
  - Package demonstrated (short term) to >1200C
  - Materials capability to >1600C
- Speed of measurement demonstrated to <1sec
- Faster version under development for different application
  - Potential for heat flow measurements
  - Ultra-high temperature





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