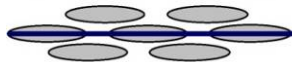

Oxsensis: 1000°C Sensors for Planes, and Power Stations UKTI – UK Advanced Engineering 2009

4th February at Williams RBS Conference Centre

David Gahan, CEO

Oxsensis



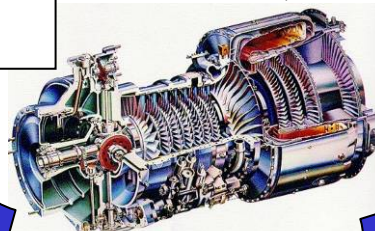
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Our Business Focus: Extreme environment Sensors improve Energy Efficiency



Better Sensors

- Pressure & Temperature
- 1000-2000°C



Better Control

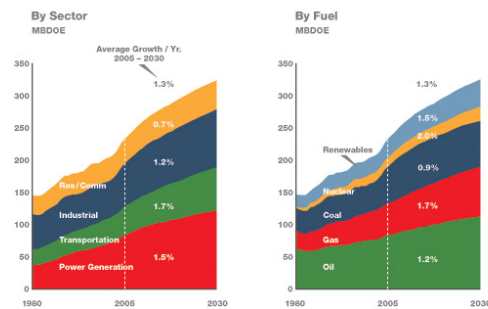
- Run hotter - path to higher efficiency "Lean Burn"
- Closed loop control

Major Savings

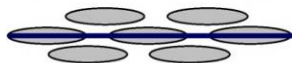
- Direct fuel savings – multiple %
- Lower equipment costs, spares
- Lower emissions trading costs

- Major growth in world energy needs, air and surface transportation
- Urgent need for better fossil fuel efficiency, multiple % possible - better sensors are absolutely required
- We are developing extreme environment fibre optic sensors to enable step-by-step improvements in energy and transport
- Key is higher temperatures

World Energy Demand and Supply



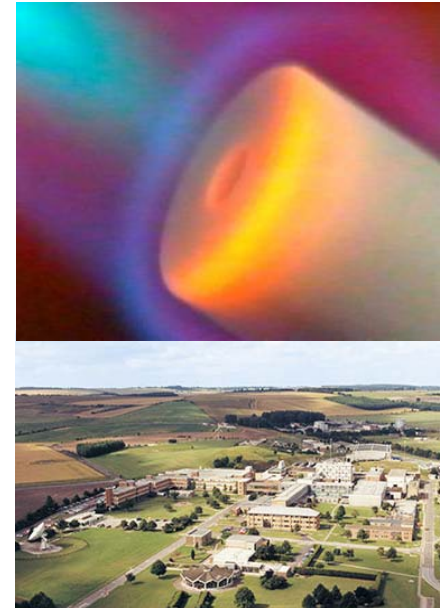
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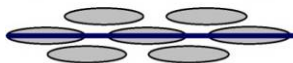
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Oxsensis Background

- 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
- Established production in 2008
- US presence, Raleigh NC



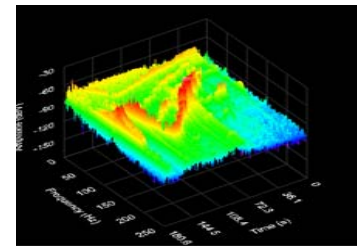
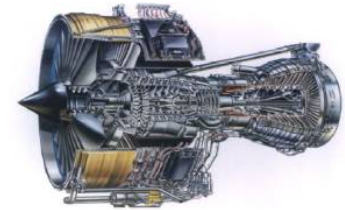
Oxsensis



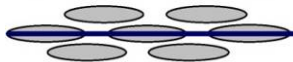
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Active in 4 Market Sectors

- 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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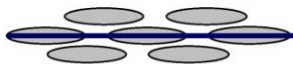


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Why? Combustion control in gas turbines and car engines

- Multiple % savings in aero engines and power generation
 - * Feedback loops vital, combustion, vari-fuel optimisation etc
- E.g. ACARE targets for aviation require 25% reduction in CO2 per passenger km from engines
- Less NOx (acid rain)

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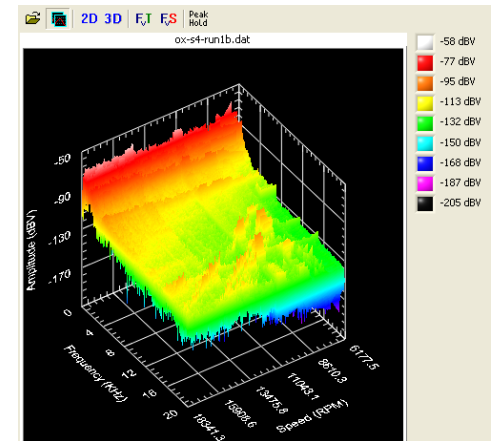


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Oxsensis Product Offerings



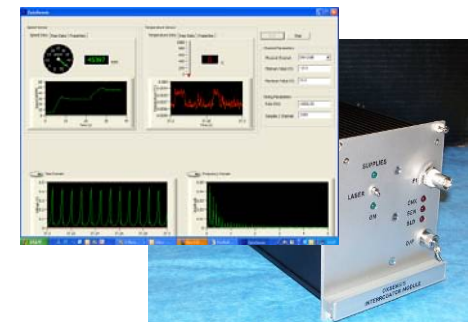
S-Phire™ Software Package



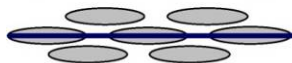
Wave-Phire™ Dynamic Pressure and Temperature Sensors



i-Phire™ Sensor Interrogator



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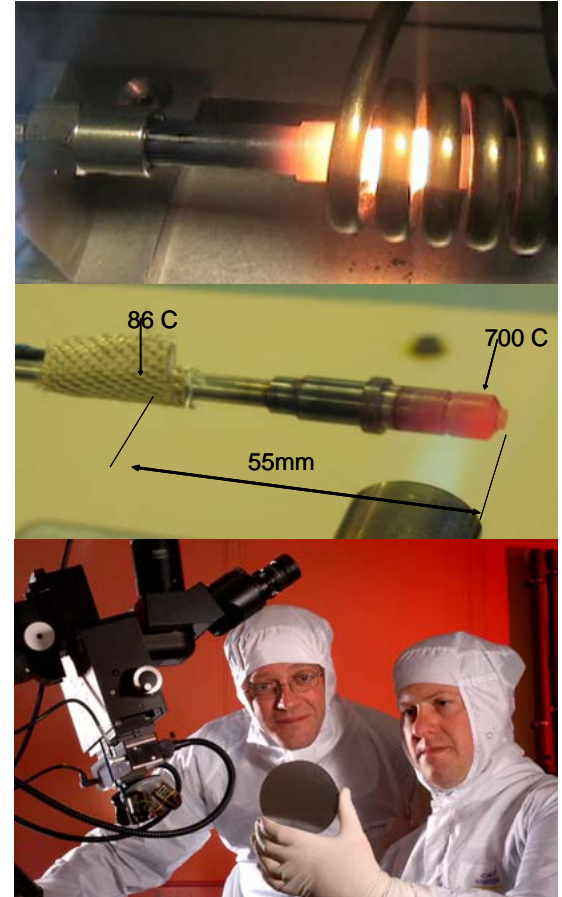
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Differential Advantage in Harsh Environment Sensors

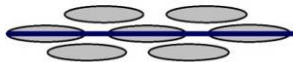
World leading performance at 1000°C for Wave-Phire™

Oxsensis has a unique combination of:

- Sapphire and silicon micromachining technology
 - * Sapphire melting point 2053°C
- High temperature materials processing and packaging
- Fibre-optics and photonics systems experience
- Software analysis
- Applications knowledge from Power industry
- Link with internationally famous Rutherford Appleton Laboratory



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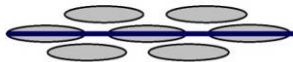
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1000C+ Wave-Phire™ Sensors offer future Combustion Management platform

- New Platform with >300C headroom over conventional sensors:
 - * Conventional limited to ~700C
 - * “Future Platform” for many needs
- Greatly simplified measurements:
 - * Flush mounted measurements
 - * No water cooling
 - * No electrical interference (EMI)
 - * Capability for **3 sensors in 1**
 - * Static and Dynamic Pressure, and single point Pressure / Temperature



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Dynamic Pressure Sensor



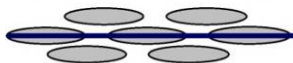
Wave-Phire™ DPT1270 dynamic pressure sensor

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



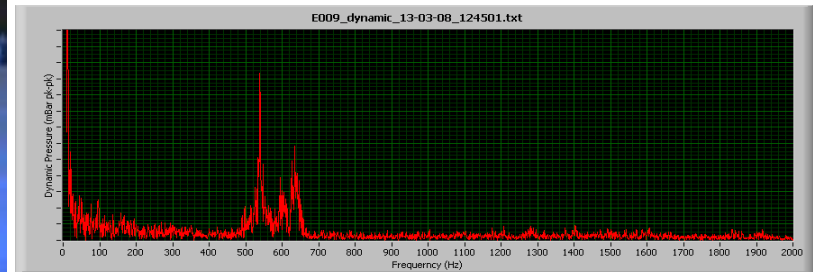
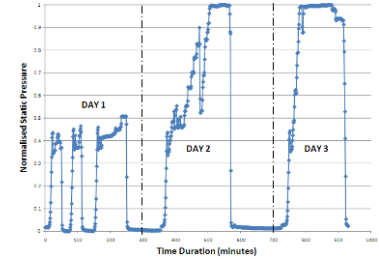
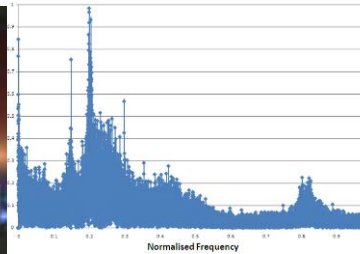
Wave-Phire™ DPT950 dynamic pressure sensor

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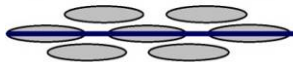
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Trials in 200MW Gas Turbine and Combustor



- Successful acquisition of both static and dynamic pressure data in full scale power gas turbine
- Sensor successfully operated for:
 - * Multiple engine starts
 - * Various running conditions
- Combustor trial - data recorded at 1000°C
- Demonstrated multi-channel interrogator
- Pictures courtesy of Siemens AG and Rolls-Royce plc

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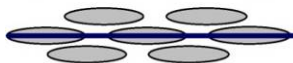


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New Direction – Fast Temperature Sensor

- Very fast, robust Wave-Phire™ temperature sensor
- Applications in:
 - * Power gas turbine combustion control – flame-outs, flashback, high H2 fuels
 - * Aircraft engines

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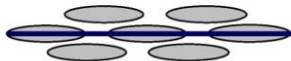


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Summary and Acknowledgments

- Desperate need to improve use of Fossil fuels – world economy depends on them
- Manufacturers are struggling to increase efficiencies - high temperature sensors are a vital part of the solution
- Oxensis has important relationships with many of the biggest players and conducts live trials in Europe, US and Japan
- Oxensis gratefully acknowledges the support of:
 - * Technology Strategy Board (TSB)
 - * Science and Technology Facilities Council (STFC)
 - * Micro-Nano Technology Centre
 - * SEEDA
 - * Commission of the European Communities
 - * Framework Programme 6
 - * UKTI
 - * Siemens AG and Rolls-Royce plc

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