

Thermal Barrier Sensor Coatings for Gas Turbine Applications

July 10, CAME-GT 2003
Brussels



***Southside Thermal
Sciences (STS) Limited***

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Outline

- **Background STS Ltd.**
- **“Sensor” Coating technology**
- **Applications and User benefits**
- **Further development**
- **Summary, Questions**



- **Spin-off Imperial College, London, UK**
- **Early stage technology**
- **Owner of IP for “Sensor” Coating technology**
- **Start of operations end 2002**
- **Access to Imperial College R&D facilities**
- **IMechE prize 2002 for most innovative paper**

Condition Monitoring Hot Section

**“ no current way to assess wear of components in real time,
...maintenance scheduled on conservative design practices
..... temperatures in hot gas path can vary by up to 100°F”**

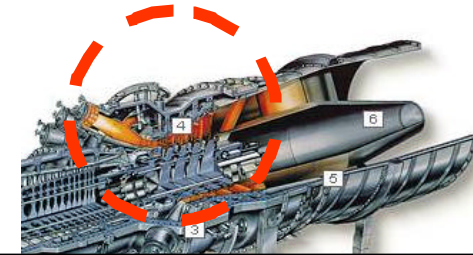
DoE Press Release, Energy Technology Lab, Dec. 2000

Current temperature measurement hot section

- at compressor discharge and exhaust
- no measurement in between
- most costly and hazardous part of turbine

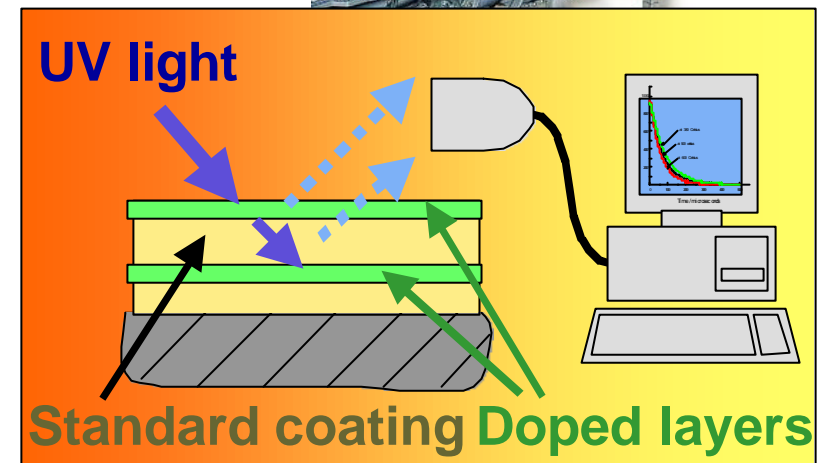
“Sensor” Coating Technology

- Standard TBC plus dopant = Sensor Coating
- UV light \rightarrow coating “phosphoresces”
- Data on coating & components



Measured Variables

Erosion	✓
Degradation	✓
Temperature	✓
Image	✓

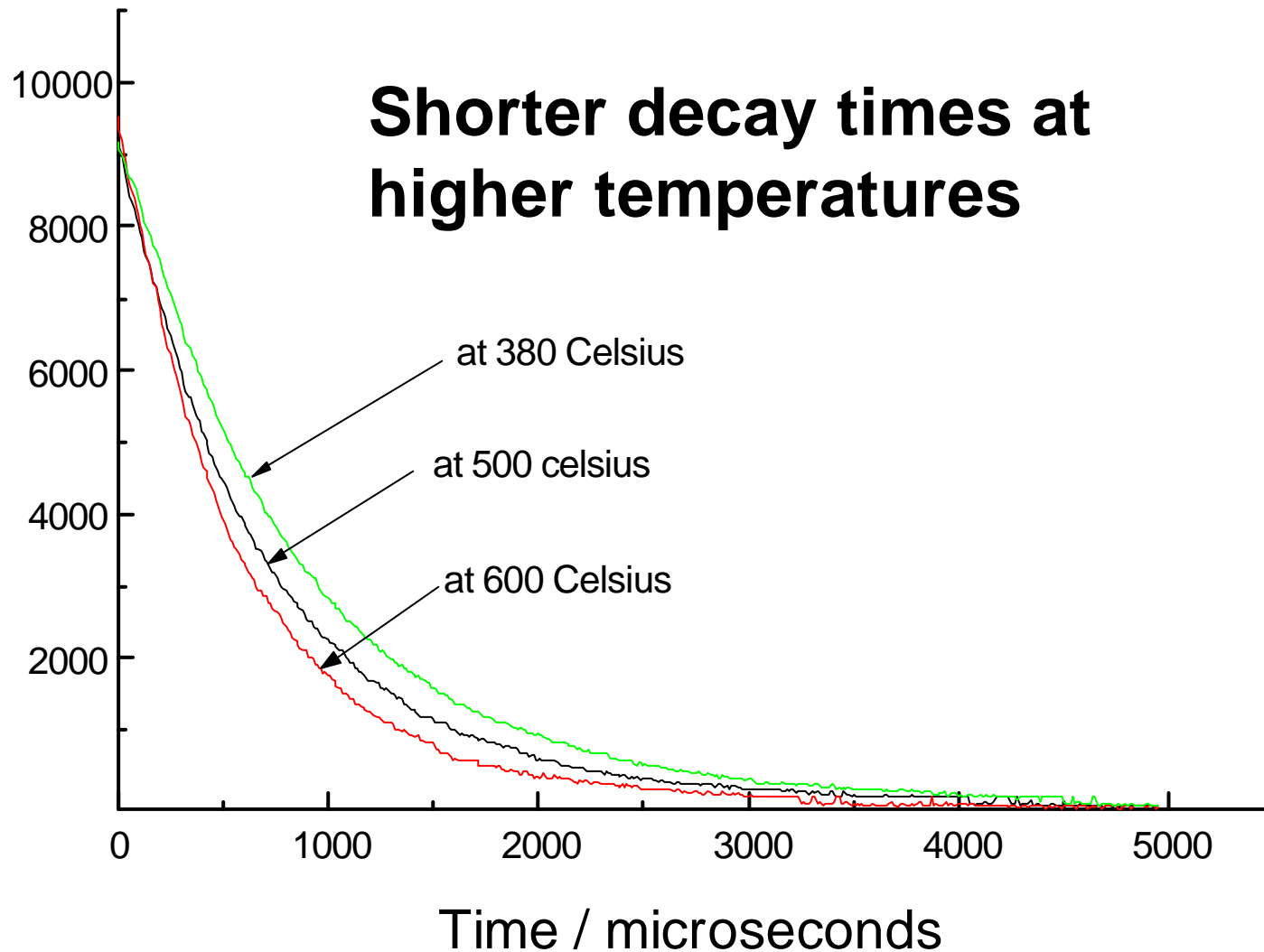


Non Destructive Evaluation

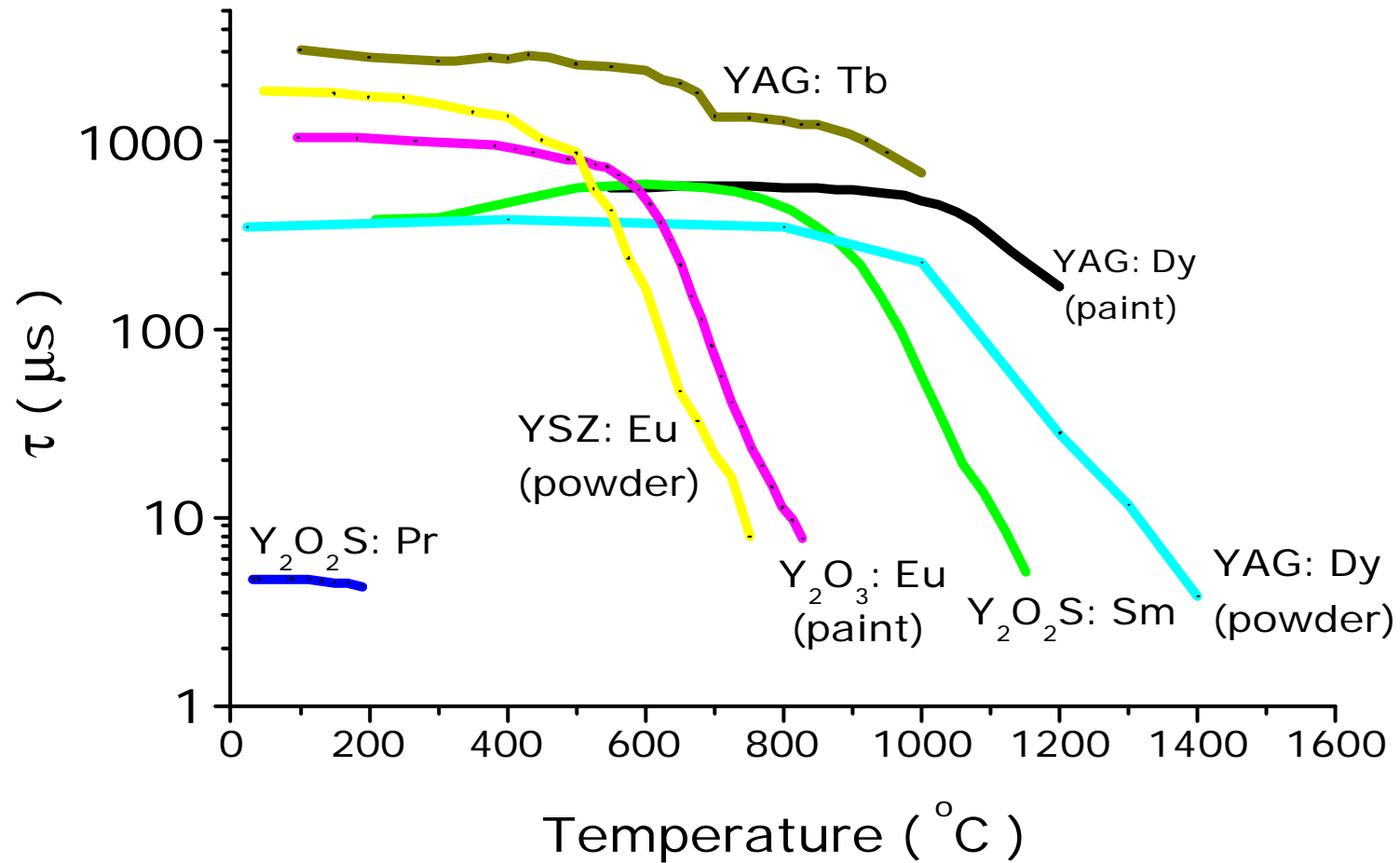
Condition Monitoring

Temperature Measurement

1st Method: Phosphor Lifetime Decay

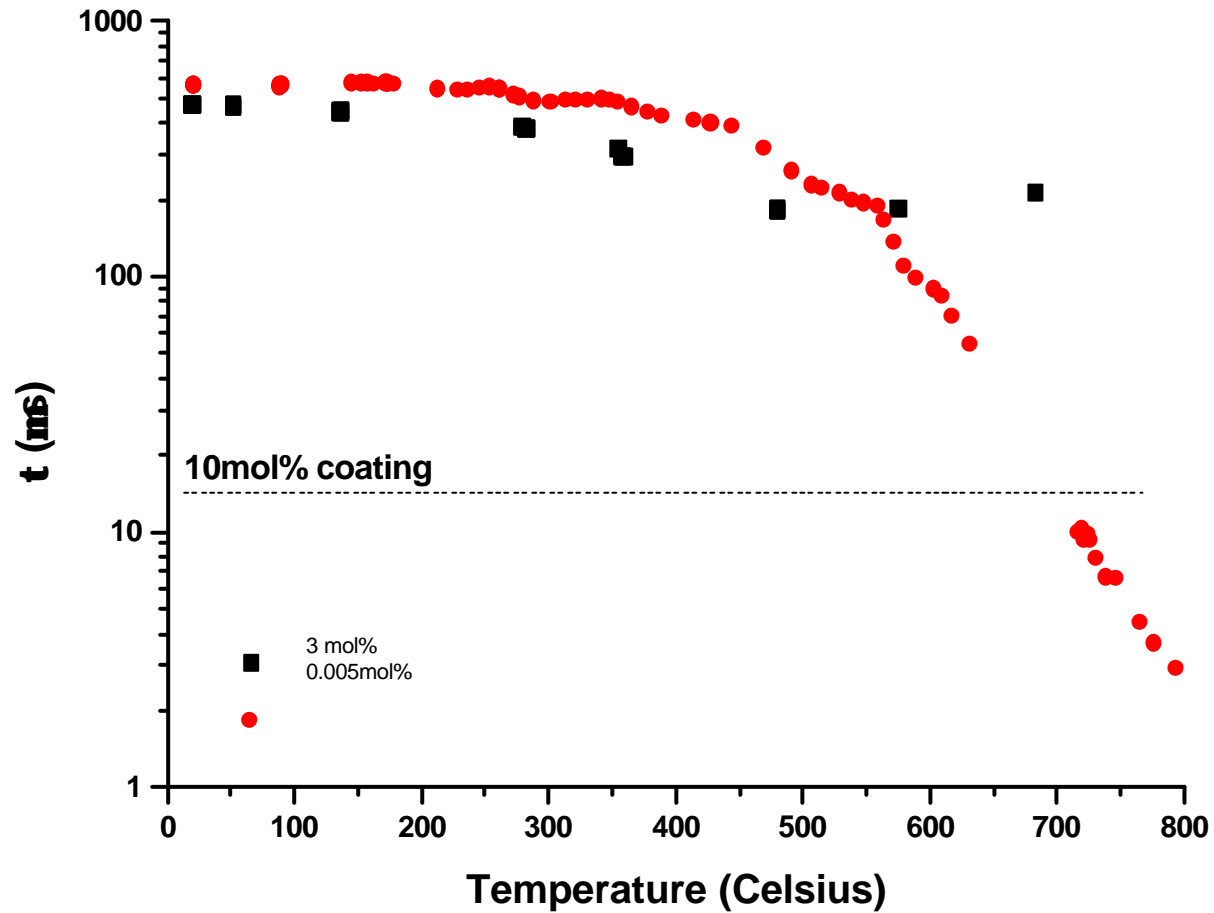


Standard Phosphors



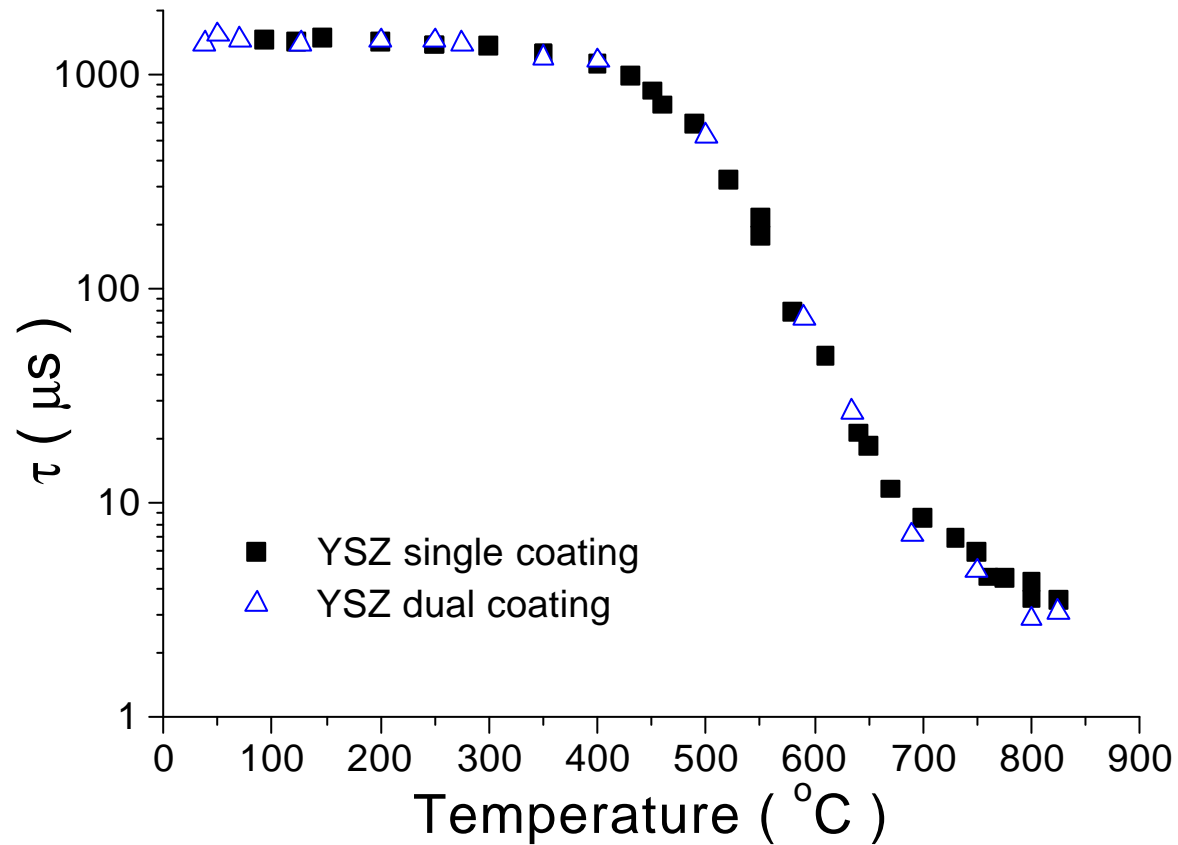
Response of YSZ: Dy powder

- Lifetime decay changes with concentration

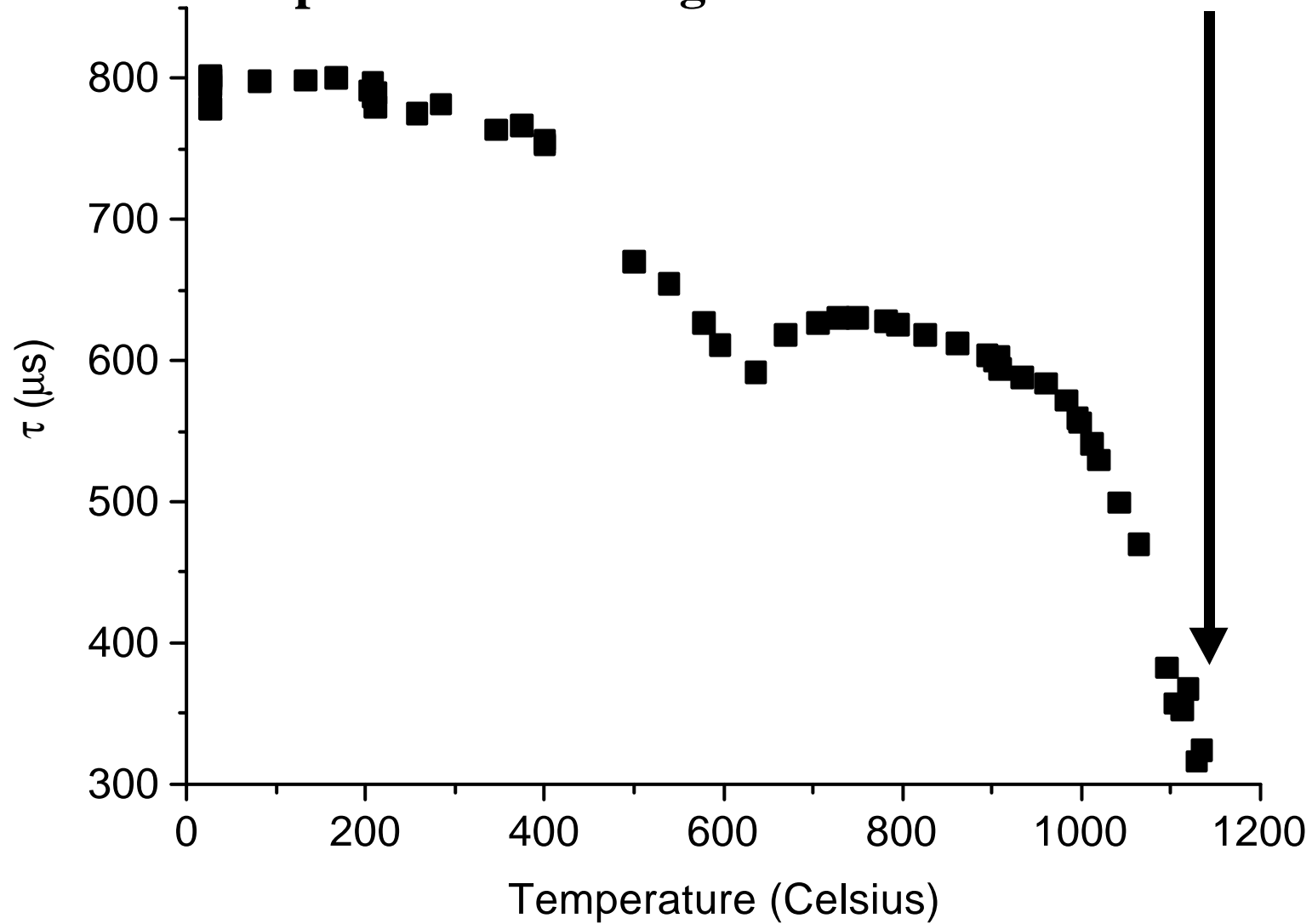


Smart TBC Response

- Lifetime decay response of the YSZ: Eu coating
- Subsurface temperature measurements



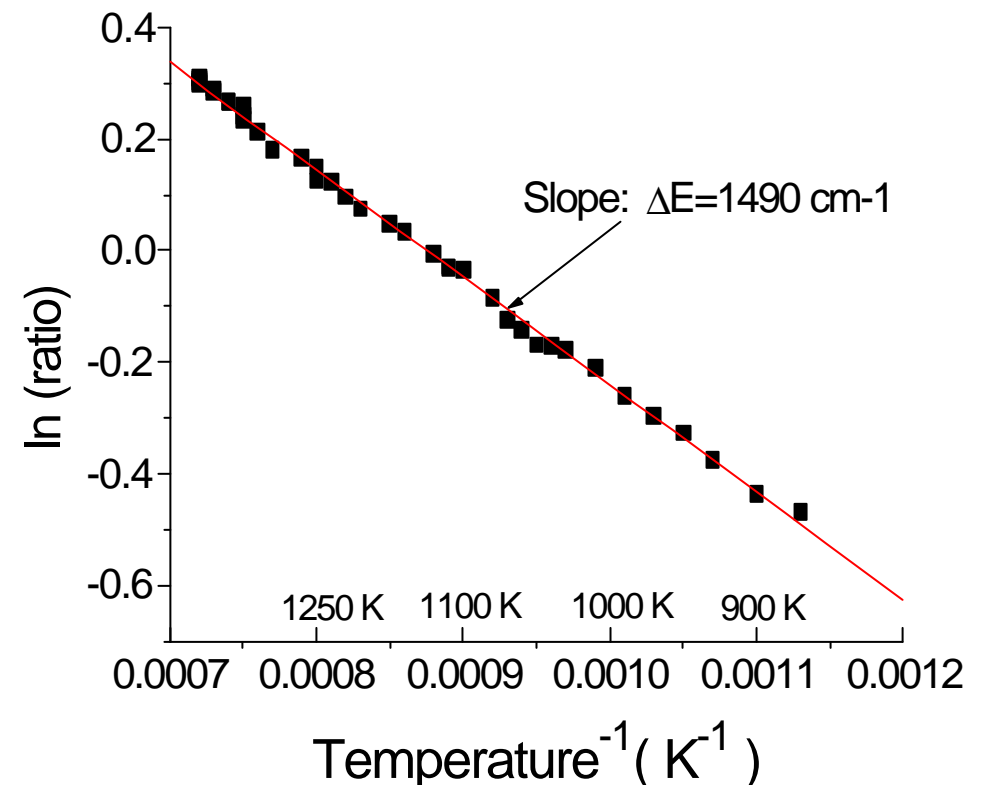
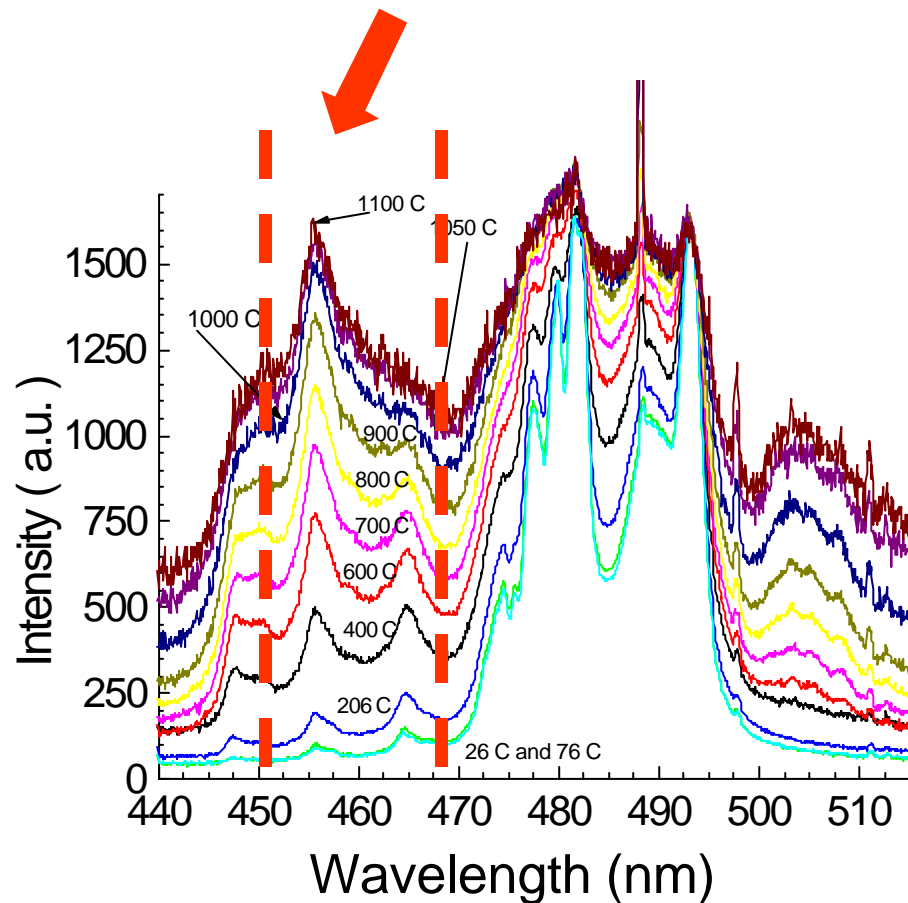
**Novel YSZ based composition:
Temperature limit higher than 1130 Celsius**



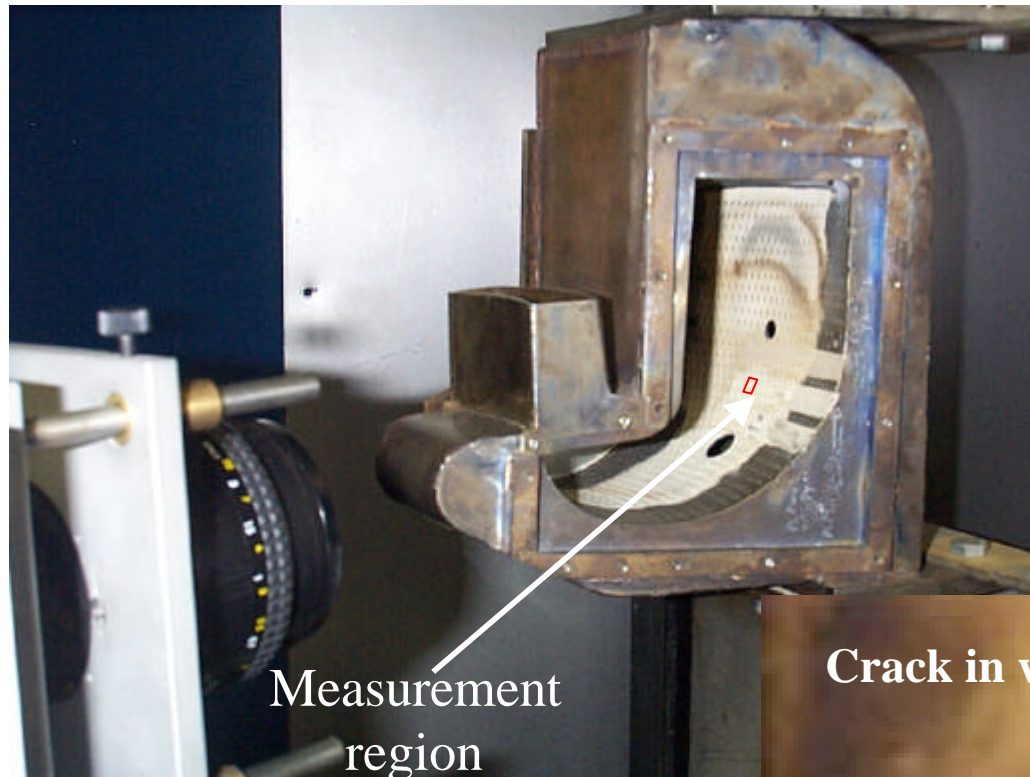
Temperature Measurement

2nd Method: Phosphor Intensity Ratio

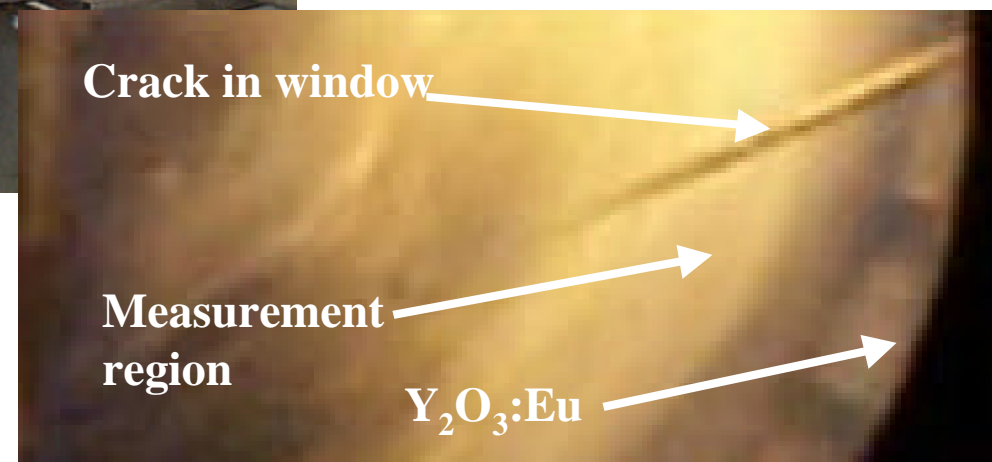
- Spectrum changes with temperature; example:
- Potential temperature distribution measurements using



Application: Combustor Measurements

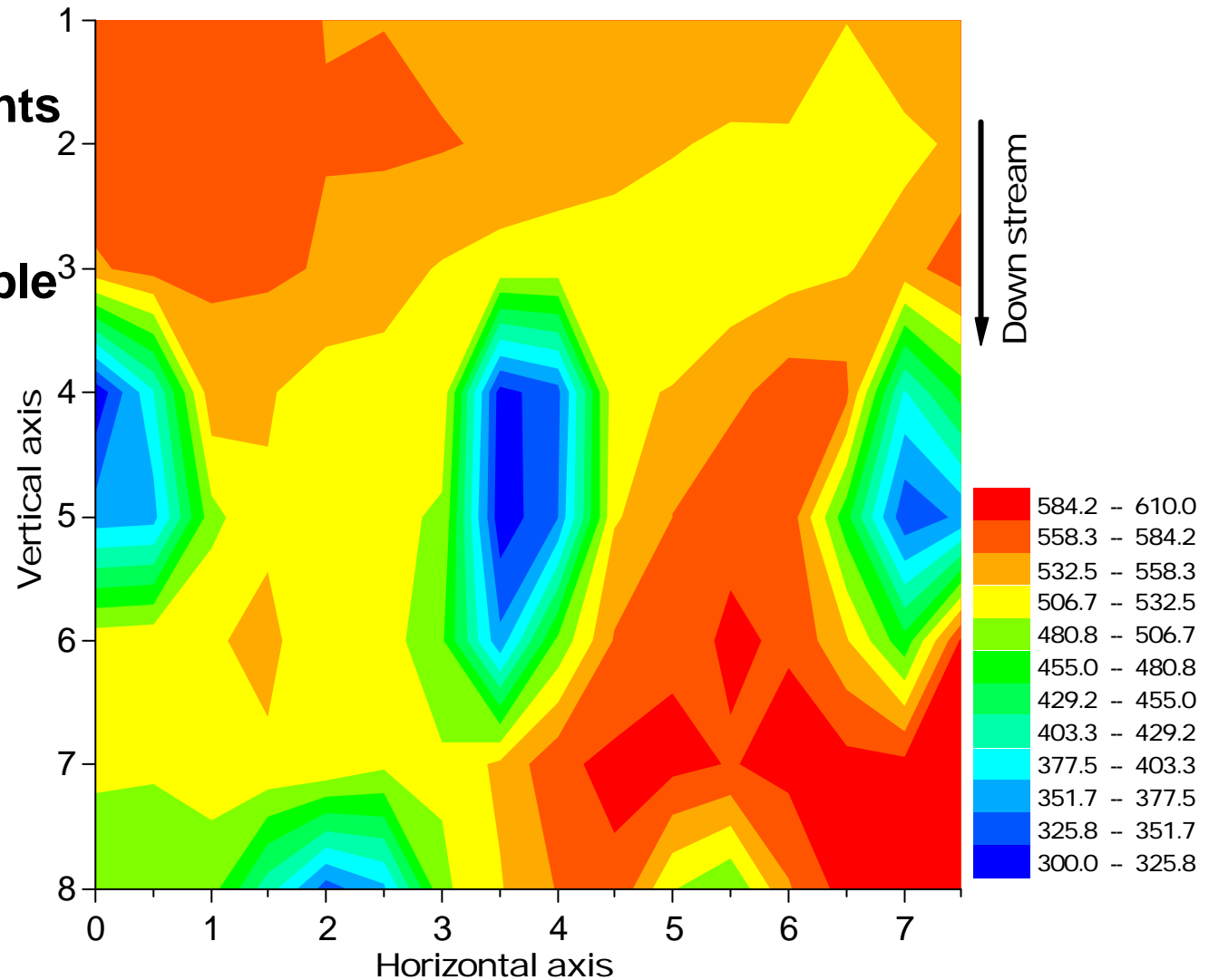


- Lifetime decay
- Y_2O_3 : Eu
- Looking through flame



Combustor Surface Temperature Distribution

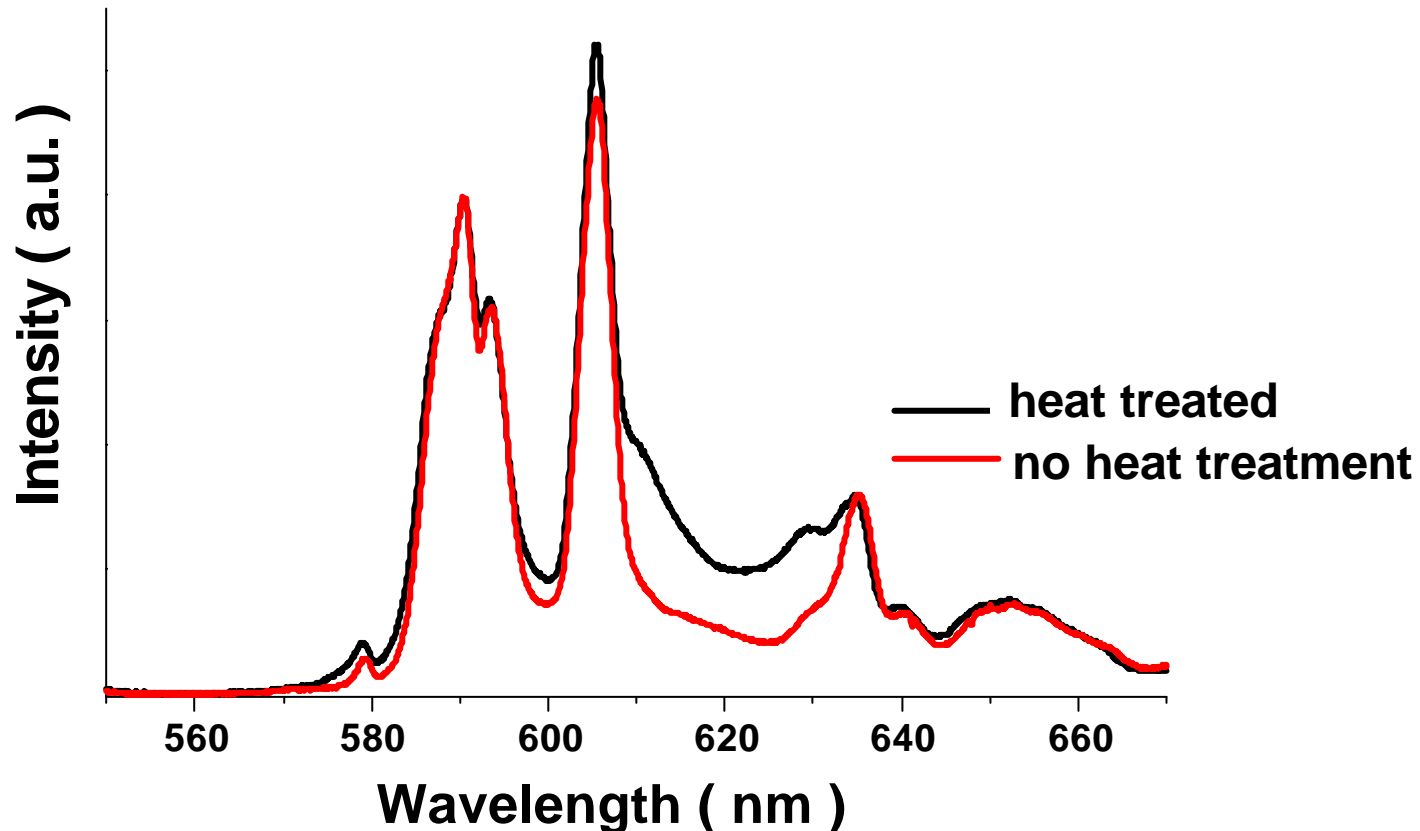
- Point measurements
- Scanned surface
(8 x 7.5 mm²)
- cooling holes visible



Degradation

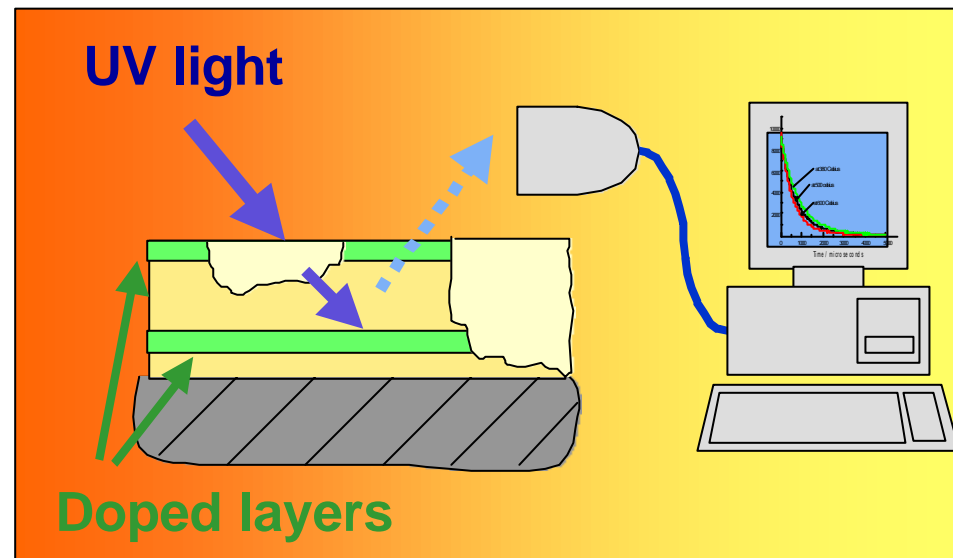
Material Phase Measurement

- Indications that changes in the material are reflected in changes in phosphorescence
- example YSZ: Eu



Erosion Measurement

Missing dopant layers allow detection of coating erosion and spallation



Applications in Condition Monitoring

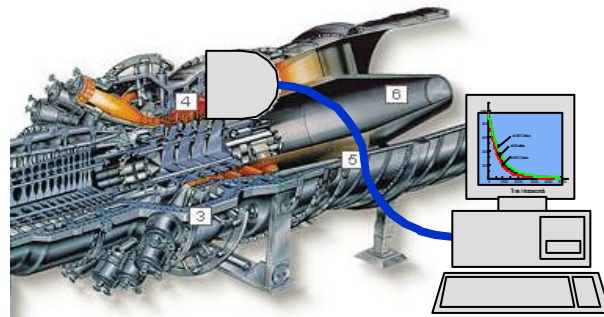
- **Lifetime prediction for coatings and blade**
 - Spallation, erosion, degradation, avoid overheating
- **Operation at optimum efficiency level, full/part load**
 - On-line temperature measurement
- **Development tool for new designs**
 - Shorter development times

User Benefits

“understand what is going on”

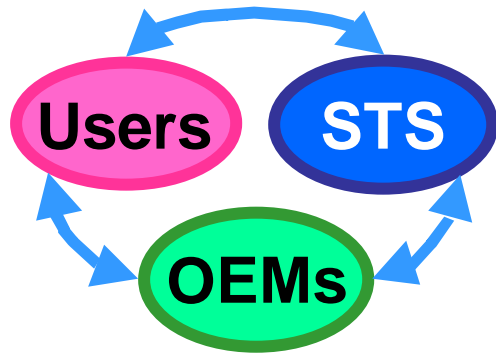


- Tool for predictive maintenance, improved RAM
- Lower Operation & Maintenance Costs
- Control Risk, balance Performance vs. Costs
- Efficiency gains through temperature control
- Improved emissions control



Technology Development

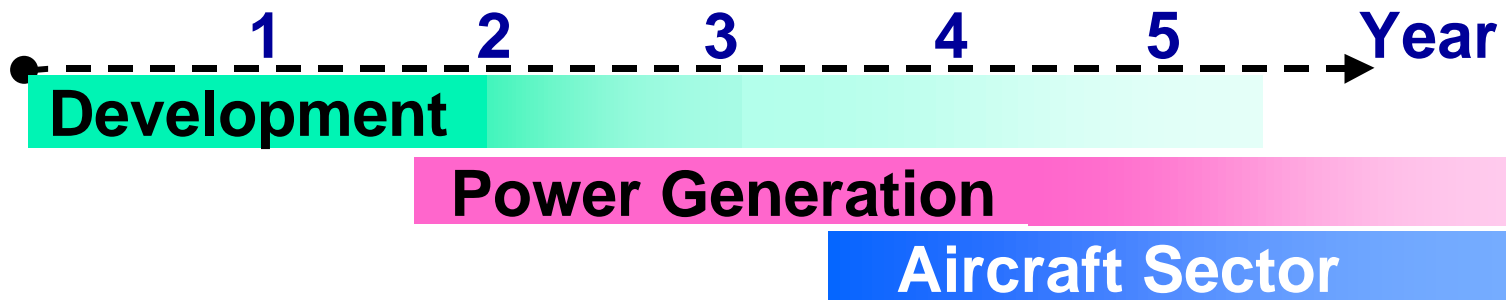
Co-operation in development



licence to OEMs



integrate in existing systems



Summary

- **Enabling Technology for data collection**
- **Development is required until ready for application**
- **Integration in existing O&M systems**

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The Wall Street Journal Europe

November 22nd 2002

European Innovations Award 2002



“Winner Base Technology/Materials”