

PROGRAM

Thermal Barrier Coatings II

August 12-17, 2007

**Kloster Irsee/Swabian Conference Center
Irsee, Germany**

Conference Chairs

Dr. Ram Darolia

Dr. Michael J. Maloney

Professor Kevin Hemker

Professor Christoph Leyens

Professor Yutaka Kagawa

ECI

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Sunday, August 12, 2007

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| 16:00 – 18:00 | Registration |
| 18:15 - 19:30 | Organ Concert:
Roland Götz, Organist, will play on the historic organ of the monastery church |
| 19:30 – 21:00 | Dinner (Bierstube) |
| 21:00 – 22:00 | Reception (Bierstube) |

Monday, August 13, 2007

- 07:00 – 08:00 Breakfast
- 08:00 – 08:15 Conference Overview: Ram Darolia, GE (Retired)

SESSION 1: OVERVIEWS

Chair: Mike Maloney, Pratt and Whitney

- 08:15 – 09:15 Tony Evans, University of California-Santa Barbara
Influence of materials technology on the fuel efficiency of aeroturbines
- 09:15 – 10:00 Kevin J. Hemker, Johns Hopkins University
A collaborative effort to model intrinsic TBC delamination
- 10:00 – 10:15 Coffee Break
- 10:15 – 11:00 David Rickerby, Rolls Royce
TBC experience in aero engines

SESSION 2: BOND COATS

Chairs: Don Lipkin, GE Global Research
John Nicholls, Cranfield University

- 11:00– 11:45 Brian Gleeson, Iowa State University
Advancements in the development of modified γ -Ni/ γ' -Ni₃Al bond coatings
- 11:45 – 12:15 Discussion
- 12:15 – 13:30 Lunch
- 13:30 – 14:15 Willem J. Quadackers, Forschungszentrum Jülich GmbH
Significance of processing steps for TGO formation on bond coats for TBC systems
- 14:15 – 15:00 Pascale Kanoute, ONERA
Determination of consecutive laws of the TBC bondcoat alloys using an instrumented micro-indentation
- 15:00 – 15:30 Kyoko Kawagishi/ Hiroshi Harada, National Institute for Materials Science
Development of TBC systems for advanced Ni-base single-crystal super alloys
- 15:30 – 16:00 Coffee Break
- 16:00 – 16:30 Wilem G. Sloof / Thijs J. Nijdam, Delft University of Technology, and Netherlands
Institute for Metals Research, The Netherlands
Bond coating pre-treatments to improve TBC
- 16:30-17:00 Alfred Scholz, Darmstadt University of Technology
Influence of the bond coat roughness on the lifetime of APS thermal barrier coatings
under thermo-mechanical load
- 17:00 – 18:00 Discussion

Monday, August 13, 2007 (continued)

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| 18:30 – 19:45 | Dinner |
| 19:45 – 21:00 | Industry Panel represented by GE Aviation (Mike Carroll), PWA (Mike Maloney), Rolls Royce (David Rickerby), Honeywell (Tom Strangman), Howmet (Ken Murphy), Siemens (Matthias Oechsner), Snecma (Florent.bourlier), Alstom (Wolfram Beele)
Moderator: Tresa Pollock, University of Michigan |
| 21:00 – 22:00 | Social Hour |

Tuesday, August 14, 2007

07:00 – 08:00 Breakfast

SESSION 3: FUNDAMENTALS OF OXIDATION

Chair: Brian Gleeson, University of Pittsburgh

08:00 – 09:00 Gerald H. Meier, University of Pittsburgh
Oxidation and corrosion in high-temperature systems

09:00 – 09:45 David R. Clarke, University of California-Santa Barbara
Optimizing coating/superalloy combinations for maximum thermal barrier coating life

09:45 – 10:00 Coffee Break

10:00 – 10:45 Bruce Pint, ORNL
Oxidation behaviour in the NI-AL-PT-HF system

10:45 – 11:15 Peggy Y. Hou
An experimental study of segregation and strength of Al₂O₃/NiAl interfaces

11:15 – 11:45 John R. Smith, University of California- Santa Barbara
A first-principles study of Ni(Al)Al₂O₃

11:45 - 12:15 Discussion

12:15 –
Boxed lunch
Optional Excursion

18:00 – 19:00 Dinner

SESSION 4: CMAS MECHANISMS AND MITIGATION

Chair: Ram Darolia, GE (Retired)

19:00 – 19:45 Carlos G. Levi, University of California-Santa Barbara
CMAS on TBCS: Mechanism and issues in mitigation

19:45– 20:15 Hayden Wadley, University of Virginia
Multilayered thermal barrier coatings

20:15 – 21:00 Nitin Padture, The Ohio State University
Engineering of ceramic top-coats in thermal barrier coatings

21:00 – 21:30 Discussion

21:30 – 23:00 Social Hour

Wednesday, August 15, 2007

07:00 – 08:00 Breakfast

SESSION 5: TOP COAT BEHAVIOR

Chairs: Carlos Levi, University of California at Santa Barbara
Christoph Leyens, Brandenburgische Technische Universität Cottbus
Uwe Schulz, DLR, Institute of Materials Research, Germany

08:00 – 09:00 Bob Miller, NASA Glenn Research Center
History of TBC

09:00 – 09:45 Dongming Zhu, NASA Glenn Research Center
The development of turbine airfoil thermal barrier coatings for improved erosion and impact resistance

09:45 – 10:15 Coffee Break

10:15 – 11:00 Uwe Schulz, DLR, Institute of Materials Research, Germany
Factors that influence the thermal conductivity of EB-PVD thermal barrier coatings

11:00 – 11:45 Robert Vassen, Forschungszentrum Jülich GmbH
Sintering of plasma-sprayed conventional and advanced thermal barrier coatings

11:45 – 12:15 Valery Shklover, Department of Materials, ETH-Zurich
High-temperature thermal conductivity of porous micro- and nanostructures

12:15 – 13:30 Lunch

13:30 – 14:15 Hans-Peter Bossmann, Alstom (Switzerland) Ltd.
Thermal and environmental stability of YTTRIA partially stabilised zirconia

14:15 – 15:00 Sanjay Sampath, State University of New York, Stony Brook
Processing strategies for optimizing compliance and thermal conductivity of plasma sprayed TBCS

15:00 – 15:30 R.M. McMeeking, University of California- Santa Barbara
Models for erosion and foreign object damage of columnar zirconia TBCS

15:30 – 16:00 Afternoon coffee

16:00 – 16:30 Bernd Baufeld, Katholieke Universiteit Leuven
Thermal conductivity of electrophoretically deposited zirconia coatings

16:30 – 17:00 Carlo Giolli, Turbocoating S.p.A.
Development of thick thermal barrier coatings with improved resistance to thermal cycling fatigue

Wednesday, August 15, 2007 (continued)

17:00 – 18:00 Discussion

18:30 – 19:45 Dinner

20:00 – 22:00 Poster Session and Social Hour
Chair: Kevin Hemker, Johns Hopkins University

Thursday, August 16, 2007

07:00 – 08:00 Breakfast

SESSION 6: FAILURE MECHANISMS

Chairs:

Tony Evans, University of California at Santa Barbara

Kevin Hemker, Johns Hopkins University

John Hutchinson, Harvard University

08:00 – 09:00 John Hutchinson, Harvard University
Cracking and delamination of thermal barrier coatings subject to thermal gradients

09:00 – 09:45 Yutaka Kagawa and Sang-Seok Kim, RCAST, The University of Tokyo
Damage evolution in an EB-PVD thermal barrier coating system under cyclic thermo-mechanical loading

09:45 – 10:15 Coffee Break

10:15 – 11:00 M. Oeschner, Siemens
TBC experience in land based turbines

11:00 – 11:30 Daniel S. Balint, Imperial College London
A computational model for TBC damage detection and lifetime prediction

11:30 – 12:00 Discussion

12:00 – 13:30 Lunch

13:30 – 14:00 Daniel Mack, Forschungszentrum Jülich GmbH, Institute of Energy Research (IEF)
Multilayered TBC-systems for increased temperatures

14:00 – 14:30 Dan Sordelet, Iowa State University, Ames Laboratory
Surface rumpling of aluminide coatings

14:30 - 15:00 Olga Fabrichnaya, TU Bergakademie Freiberg
Thermodynamic modelling in the ZrO₂-based systems

15:00 – 15:30 Afternoon coffee

15:30 – 16:00 Shengkai Gong, Beijing University of Aeronautics and Astronautics
Lanthanum oxides based ceramics as thermal barrier coating materials for high temperature applications

16:00 – 16:30 Discussion

18:30 - Conference dinner followed by Speaker (TBD) and social hour

Friday, August 17, 2007

07:00 – 08:00 Breakfast

SESSION 7: CHARACTERIZATION AND LIFE PREDICTION

Chair: David Clarke, University of California at Santa Barbara

08:00 – 08:45 J.R. Nicholls, Cranfield University
Towards TBC intelligence – Is this the next technology step forward

08:45 – 09:15 Ping Xiao, University of Manchester, School of Materials
Characterisation of thermal barrier coatings using impedance spectroscopy, fluorescence spectroscopy and nano-indentation

09:15 – 09:45 Wolfgang Braue, German Aerospace Center (DLR) Materials Research Institute
TGO microstructures of EB-PVD thermal barrier coatings during the later stages of lifetime

09:45 – 10:15 Coffee Break

10:15 – 10:45 Rudder Wu, Department of Materials, Imperial College London
Influence of bond coat type on TBC response to thermal cycling

10:45 – 11:15 Claudia Rinaldi, CESI RICERCA
Coating residual life evaluation of components with EB-PVD TBCS operated both in base load and cycled conditions

11:15 – 11:45 Wrap-up discussions

12:15 – 13:30 Lunch and departure