

Program

Thermal Barrier Coatings III

August 7-12, 2011

**Kloster Irsee
Irsee, Germany**

Conference Chair:

Dr. Michael J. Maloney
Pratt & Whitney, USA

Conference Co-Chairs:

Dr. Uwe Schulz, German Aerospace Center, Germany

Dr. David Rickerby, Rolls-Royce UK

Dr. Ram Darolia, GE Aviation (Retired), USA

Dr. Odile Lavigne, ONERA DMSM/MAT, France

Dr. Hideyuki Murakami, National Institute for Materials Science, Japan

Prof. Hongbo Guo, School of Materials Science and Engineering, Beihang University,
China



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Pratt & Whitney



Sunday, August 7, 2011

- 16:00 - 18:00 Registration (Hospitality Desk in Kloster Irsee Lobby)
- 18:15 - 19:30 Organ Concert:
Roland Götz, Organist, will play on the historic organ of the monastery Church
- 19:30 - 20:30 Reception (Kloster Irsee Restaurant)
- 20:30 - 22:00 Dinner (Kloster Irsee Restaurant)
- 22:00 – 23:00 Social Hour (Bierstube/Stiftskeller)

Notes

- Technical sessions will be in "Vortragsaal" (Room 128)
- Lunches and dinners will typically be in the Kloster Irsee Restaurant.
- The conference banquet will be in the Festsaal.
- Audiotaping, videotaping and photography of presentations are prohibited.
- Speakers – Please have your presentation loaded onto the conference computer prior to the session start (preferably the day before).
- Speakers – Please leave at least 3-5 minutes for questions and discussion.
- Please do not smoke at any conference functions.
- Turn your cellular telephones to vibrate or off during technical sessions.
- Be sure to make any corrections to your name/contact information on the Master Participant List or confirm (by your initials) that the listing is correct. A corrected copy will be sent to all participants after the conference.
- Participants staying at the Klosterbräu Hotel Irsee should have breakfast at the hotel. Those staying at Kloster Irsee will have breakfast at Kloster Irsee.

Monday, August 8, 2011

07:00 - 08:00 Breakfast

08:00 - 08:15 Welcome and Conference Overview
Michael Maloney, Pratt & Whitney
Ram Darolia, ECI Technical Liaison

SESSION 1: OVERVIEWS

Chair: David Shifler, Office of Naval Research, USA

08:15 - 09:00 H.-P. Bossmann
Alstom, Switzerland
RELIABLE THERMAL BARRIER COATINGS FOR HIGH-LOADED
TURBINE AND COMBUSTOR PARTS

09:00 - 09:45 Huibin Xu
Beihang University, China
RESEARCH PROGRESS ON TBCS MATERIALS FOR ULTRA-HIGH
TEMPERATURE APPLICATIONS

09:45 - 10:15 Coffee Break

10:15 - 11:00 David Rickerby
Rolls Royce, UK
LIFING AND DEGRADATION OF EB-PVD THERMAL BARRIER COATINGS

SESSION 2: BONDCOAT DEVELOPMENT AND BEHAVIOR

Chair: Brian Gleeson, University of Pittsburgh, USA

11:00 - 11:40 Teresa Pollock
University of California, Santa Barbara, USA
COMBINATORIAL STUDIES OF NIAL-BASED OVERLAY BOND
COATINGS

11:40 - 12:20 Shengkai Gong,
Beihang University, China
NEW BOND COAT MATERIALS IN TBC SYSTEM FOR ADVANCED SINGLE
CRYSTAL SUPERALLOY

12:20 - 13:30 Lunch

13:30 - 14:10 Akihiro Sato
Research Laboratory, IHI Corporation, Japan
DEVELOPMENT OF NEW PT- γ + γ' TYPE BOND COATINGS FOR
ADVANCED NI-BASE SINGLE CRYSTAL SUPERALLOYS

14:10 - 14:40 Discussion

Monday, August 8, 2011 (continued)

SESSION 3: FUNDAMENTALS OF OXIDATION

Chair: Gerald Meier, University of Pittsburgh, USA

- 14:40 - 15:20 Brian Gleeson
University of Pittsburgh, USA
COMPOSITIONAL FACTORS AFFECTING THE OXIDATION BEHAVIOR
OF CURRENT AND DEVELOPMENTAL BOND COATING SYSTEMS
- 15:20 - 15:50 Afternoon Coffee Break
- 15:50 - 16:30 Dimitry Naumenko
Juelich, Germany
OXIDATION OF MCRAly-BONDcoATS AND ITS INFLUENCE ON
THE THERMAL CYCLIC LIFETIME OF YSZ TBC SYSTEMS
- 16:30 – 16:50 Roger Reed (presented by Rudder Wu)
University of Birmingham, UK
FACTORS CONTROLLING ADHESION OF TBC SYSTEMS TO NICKEL-
BASED SUPERALLOYS
- 16:50 – 17:10 Rudder Wu
ICYS, National Institute for Materials Science, Japan
TOWARDS A DETAILED UNDERSTANDING OF THE FUNDAMENTAL
MECHANISMS UNDERLYING THE BENEFICIAL EFFECTS OF PLATINUM
MODIFICATION
- 17:10 – 17:50 Vladimir Tolpygo
Honeywell, USA
ON THE ORIGIN OF STRESSES IN ALUMINIDE BOND COATS DURING
SERVICE AT HIGH TEMPERATURES
- 17:50 - 18:10 Discussion
- 19:00 - 20:30 Dinner
- 20:30 - 22:00 Social Hour

Tuesday, August 9, 2011

07:00 - 08:00 Breakfast

SESSION 4-1: TOP COAT DEVELOPMENT AND CHARACTERISTICS

Chairs: Uwe Schulz, DLR, German Aerospace Center, Germany
Richard Wellman, Cranfield University, UK

08:00 - 08:40 Konstyantyn Yakovchuk
ICEBT, Ukraine

ELECTRON BEAM TECHNOLOGY AND EQUIPMENT FOR
DEPOSITION OF GRADED TBC

08:40 - 09:20 Frederic Rousseau

LGPPTS Ecole Nationale Supérieure de Chimie de Paris, France
DEVELOPMENT OF A LOW PRESSURE PLASMA DEPOSITION
TECHNIQUE TO IMPROVE THE PROPERTIES AND THE
RESISTANCE OF THERMAL BARRIER COATINGS

09:20 - 10:00 Robert Vassen

Juelich, Germany
SUSPENSION PLASMA SPRAYING FOR THE MANUFACTURE OF
ADVANCED THERMAL BARRIER COATINGS

10:00 - 10:30 Coffee Break

10:30 - 11:10 Derek Hass

DVTI, USA
PROCESSING OF ADVANCED THERMAL BARRIER COATINGS
VIA DIRECTED VAPOR DEPOSITION

11:10 - 11:40 Roman Kubrin

Hamburg University of Technology, Germany
MULTILAYER 3D PHOTONIC CRYSTALS FOR APPLICATION AS
HIGHLY REFLECTIVE THERMAL BARRIER COATINGS

11:40 - 12:10 Lucy Y. Liu

Chromalloy Gas Turbine LLC, USA
A NEW APS MULTILAYER TBC WITH LOW K AND HIGH DURABILITY

12:10 - 12:30 Discussion

12:30 -

Boxed Lunch
Optional Excursion

18:00 - 19:00 Dinner

Tuesday, August 9, 2011 (continued)

SESSION 4-2: TOP COAT DEVELOPMENT AND CHARACTERISTICS

Chair: Robert Vassen, Forschungszentrum Jülich GmbH, Germany

- 19:00 - 19:40 Sanjay Sampath
State University of New York, USA
CONTROLLED INTRODUCTION ON ANELASTICITY IN PLASMA
SPRAYED TBCS: IMPLICATIONS FOR PERFORMANCE AND
RELIABILITY
- 19:40 - 20:20 Konstantin Von Niessen
Sulzer, Switzerland
VAPOR PHASE DEPOSITION USING A PLASMA SPRAY PROCESS
- 20:20 - 21:00 Ping Xiao
University of Manchester, UK
MICROSTRUCTURE, RESIDUAL STRESSES AND MECHANICAL
PROPERTIES OF TBCS
- 21:00 – 21:30 Discussion
- 21:30 - 23:00 Social Hour

Wednesday, August 10, 2011

07:00 - 08:00 Breakfast

SESSION 4-3: TOP COAT DEVELOPMENT AND CHARACTERISTICS

Chairs: Odile Lavigne, ONERA, DMSM/MAT, France
Kevin Hemker, Johns Hopkins University, USA

08:00 - 08:40 Gerry Meier
University of Pittsburgh, USA
THE EFFECT OF PROCESSING VARIABLES ON THE DURABILITY
OF HIGH-PURITY YSZ-TBCS PREPARED BY APS

08:40 - 09:20 Dongming Zhu
NASA, USA
ENVIRONMENTAL BARRIER COATINGS FOR SIC/SIC CERAMIC MATRIX
COMPOSITE TURBINE ENGINE HOT-SECTION COMPONENTS: ADVANCES,
APPLICATIONS AND DIRECTIONS

09:20 - 10:00 Kang Lee
Rolls Royce, USA
RECESSION OF ENVIRONMENTAL BARRIER COATINGS FOR CERAMIC
MATRIX COMPOSITES

10:00 - 10:30 Coffee Break

10:30 - 11:00 Maria Ophelia Jarligo
Julich GmbH, Germany
NEW THERMAL BARRIER COATINGS FROM COMPLEX PEROVSKITES

11:00 - 11:30 Ming Fu
GE Aviation, USA
IMPACT AND EROSION PERFORMANCE OF THERMAL BARRIER COATINGS

11:30 - 12:00 Federico Cernuschi
RSE, Italy
THERMAL DIFFUSIVITY MEASUREMENT BY THERMOGRAPHIC
TECHNIQUE FOR THE NON DESTRUCTIVE INTEGRITY ASSESSMENT OF
TBCS COUPONS

12:00 - 12:30 Discussion

12:30 - 13:30 Lunch

SESSION 5: CMAS MECHANISMS AND MITIGATION

Chairs: David Litton, Pratt & Whitney, USA
David Clarke, Harvard University, USA

13:30 - 14:10 Carlos Levi
University of California, Santa Barbara, USA
CMAS: LESSONS LEARNED AND PERSPECTIVES

Wednesday, August 10, 2011 (continued)

- 14:10 - 14:50 Peter Mechnich
DLR, Germany
THERMOCHEMICAL ATTACK OF ARTIFICIAL AND NATURAL
VOLCANIC ASHES ON 7 YSZ AND PYROCHLORE TBCS
- 14:50 - 15:20 Wolfgang Braue
DLR, Germany
GARNET-TYPE REACTIVE INTERFACES FROM FE-TI-CMAS HOT
CORROSION OF YSZ COATED ENGINE HARDWARE
- 15:20 - 15:50 Coffee Break
- 15:50 - 16:20 M.H. Vidal-Setif
ONERA, France
CMAS DEGRADATION OF EB-PVD THERMAL BARRIER COATINGS:
FROM EX SERVICE EXAMINATIONS TO LABORATORY TESTS
- 16:20 - 17:00 Nitin Padture
The Ohio State University, USA
PLASMA-SPRAYED THERMAL BARRIER COATINGS THAT ARE
RESISTANT TO DAMAGE BY MOLTEN DEPOSITS: CMAS SAND,
VOLCANIC ASH, AND COAL FLY ASH
- 17:00 - 17:30 M. Shinozaki
University of Cambridge, UK
THE EFFECT OF CMAS- ASSISTED SINTERING ON THE
THERMOMECHANICAL STABILITY OF PLASMA- SPRAYED TBCS
- 17:30 - 18:00 Discussion
- 18:30 - 19:45 Dinner
- 20:00 - 22:00 **SESSION 6: POSTER SESSION** and Social Hour
Chair: Sanjay Sampath, SUNY Stonybrook, USA

Thursday, August 11, 2011

07:00 - 08:00 Breakfast

SESSION 7: FAILURE MECHANISMS

Chairs: David Rickerby, Rolls Royce, UK

Ram Darolia, General Electric (retired), USA

Teresa Pollack, University of California Santa Barbara, USA

08:00 - 08:40 Ramesh Subramanian
Siemens, USA

ADVANCED MULTI-FUNCTIONAL COATINGS FOR LAND-BASED
INDUSTRIAL GAS TURBINES

08:40 - 09:20 David Clarke
Harvard University, USA

PROPERTY AND DAMAGE EVOLUTION IN THERMAL BARRIER COATINGS

09:20 - 10:00 Wim G. Sloof
Technical University of Delft, Netherlands

DAMAGE GROWTH TRIGGERED BY INTERFACE IRREGULARITIES IN
THERMAL BARRIER COATINGS

10:00 - 10:30 Coffee Break

10:30 - 11:10 Yutaka Kagawa
University of Tokyo, Japan

EFFECT OF EXTRINSIC FACTORS FOR DEFORMATION OF EB-
PVD THERMAL BARRIER COATINGS: SOME RESULTS OF
THERMO-MECHANICAL FATIGUE TESTS

11:10 - 11:50 Kevin Hemker
John Hopkins University, USA

EXPERIMENTAL INVESTIGATIONS OF DELAMINATION TOUGHNESS
IN LAYERED PROTECTION SYSTEMS

11:50 - 12:20 Mario Schweda
Forschungszentrum Jülich, Germany

INFLUENCE OF BONDCOAT CREEP AND ROUGHNESS ON TBC-DAMAGE

12:20 - 13:30 Lunch

13:30 - 14:10 Eric Jordan
University of Connecticut, USA

UNDERSTANDING APS TBC FAILURE BY SUFFICIENTLY REALISTIC
MODELING AND SUPPORTING EXPERIMENTS

14:10 - 14:50 Richard Wellman, University of Cranfield, UK

ARE EB PVD TBCS MORE EROSION RESISTANT THAN PS TBCS?

14:50 - 15:20 M. Rudolphi
Karl-Winnacker-Institut der DECHEMA, Germany

FAILURE PREDICTION OF THERMAL BARRIER COATINGS USING A
FRACTURE MECHANICS APPROACH

15:20 - 15:50 Afternoon Coffee

Thursday, August 11, 2011 (continued)

15:50 - 16:30 Matthias Oechsner
University of Darmstadt, Germany
PROPERTY VARIATIONS IN TBC SYSTEMS AND THEIR IMPACT ON
TURBINE DESIGN

16:30 - 17:30 Discussion

18:30 - Conference dinner and social hour

Friday, August 12, 2011

07:00 - 08:00 Breakfast

SESSION 8: LIFE MODELING AND CHARACTERIZATION TECHNIQUES

Chairs: Matthias Oechsner, Technische Universität Darmstadt, Germany
Yukata Kagawa, The University of Tokyo, Japan

- 08:00 - 08:40 Tilmann Beck
FZ Juelich, Germany
TBC'S FOR GAS TURBINES UNDER THERMO-MECHANICAL
LOADINGS: FAILURE BEHAVIOUR AND LIFE PREDICTION
- 08:40 - 09:20 Kyoko Kawagishi (presented by Hiroshi Harada)
National Institute for Materials Science, Japan
THERMAL CYCLIC LIFE OF EB-PVD TBC SYSTEM
- 09:20 - 10:00 Jeffery Eldridge
NASA, USA
OBSERVING DAMAGE EVOLUTION IN THERMAL BARRIER COATINGS
BY LUMINESCENCE IMAGING
- 10:00 - 10:30 Coffee Break
- 10:30 - 11:00 Pascale Kanoute,
ONERA, France
LIFE TIME ANALYSIS FOR TBC SPALLATION
- 11:00 - 11:30 Bauke. Heeg
Lumium, The Netherlands
OPTICAL DIAGNOSTICS ON THERMAL BARRIER COATING STRUCTURES
- 11:30 - 12:00 Hua Wei
Institute of Metals, Academy of Science, China
A NUMERICAL MODEL FOR FAILURE MECHANISMS OF THERMAL
BARRIER COATINGS
- 12:00 – 12:30 Wrap-up discussions
- 12:30 Lunch and Departures

Poster Presentations

1. Ashutosh S. Gandhi
Indian Institute of Technology Madras, India
FRACTURE TOUGHNESS OF RARE-EARTH STABILISED ZIRCONIA THERMAL BARRIER MATERIALS: EFFECT OF PHASE TRANSFORMATIONS
2. Gopal Dwivedi
Stony Brook University, USA
EFFECT OF MOISTURE ON THE COMPLIANCE OF THERMAL BARRIER COATINGS
3. Hui Peng
Beihang University, China
IMPROVED OXIDATION RESISTANCE OF A NOVEL NICOCRALY COATING FABRICATED BY PLASMA-ACTIVATED EB-PVD
4. Fanny Riallant
Institut Prime CNRS-ENSMA, Snecma - SAFRAN Group, France
STRESS INFLUENCE ON HIGH TEMPERATURE OXIDE SCALE GROWTH: EXPERIMENTAL INVESTIGATION ON THE AM1/NIALPT/EBPVD YSZ SYSTEM
5. Olena Trunova
Research Centre Jülich, Germany
MICROSTRUCTURAL AND ACOUSTIC DAMAGE ANALYSIS OF AIR PLASMA-SPRAYED THERMAL BARRIER COATINGS UNDER THERMAL CYCLING
6. Qing He
Chinese Academy of Agricultural Mechanization Science, China
SEGMENTED TBCS PRODUCED BY ATMOSPHERIC PLASMA SPRAYING 7YSZ POWDER WITH LOW IMPURITY CONTENT
7. Fan Yang
University of Manchester, UK
THERMAL CONDUCTIVITIES OF ZIRCONIA-CERIA-YTTRIA SOLID SOLUTIONS
8. Julie M. Drexler
The Ohio State University, USA
THERMAL GRADIENT CYCLING WITH SIMULTANEOUS SILICATE PARTICLE DEPOSITION ONTO ADVANCED AIR PLASMA SPRAYED THERMAL BARRIER COATINGS
9. Andrzej Nowotnik
Rzeszow University of Technology, Poland
TECHNOLOGY AND THE DEVELOPMENT OF ADVANCED THERMAL BARRIER COATINGS
10. Andrew D Gledhill
The Ohio State University, USA
LIFETIME MODELING OF COAL FLY ASH INFILTRATED THERMAL BARRIER COATINGS IN CYCLIC THERMAL GRADIENT TESTING
11. Ying Zhu
School of Fundamental Research, China
PREPARATION AND PROPERTIES OF HOLLOW YSZ NANO-POWDERS

12. J.-R. Vaunois
ONERA, France
EXPERIMENTAL TESTS FOR MEASURING INTERFACE FRACTURE TOUGHNESS OF THERMAL BARRIER COATINGS
13. Jessica A. Krogstad
University of California Santa Barbara, USA
REVISITING PHASE STABILITY IN T'-ZIRCONIA BASED TBCS: A COMPARISON OF APS AND EBPVD TBCS
14. Erin M. Donohue
University of California Santa Barbara, USA
MODE I DELAMINATION TOUGHNESS OF AIR PLASMA SPRAY ZIRCONIA COATINGS: EXPERIMENTAL MEASUREMENTS AND FINITE ELEMENT ANALYSIS
15. Peter Wittig
Technische Universität Darmstadt, Germany
FRACTURE MECHANICAL CHARACTERIZATION OF PLASMA-SPRAYED THERMAL BARRIER COATINGS
16. Gregoire Witz
Alstom Switzerland AG, Switzerland
ANALYTICAL TOOLS FOR INVESTIGATION OF EX-SERVICE THERMAL BARRIER COATINGS
17. Daniel E. Mack
IEK-1, Forschungszentrum Jülich GmbH, Germany
MICROSTRUCTURE EVOLUTION AND THERMAL CYCLING PERFORMANCE OF PLASMA SPRAYED ALUMINATES FOR USE AS THERMAL BARRIER COATINGS
18. Daniel E. Mack
IEK-1, Forschungszentrum Jülich GmbH, Germany
THERMOGRAPHIC ONLINE MONITORING OF FAILURE EVOLUTION OF THERMAL BARRIER COATINGS IN GAS BURNER THERMAL CYCLING RIG ENVIRONMENT
19. Ralf Webler
Institute I: General Materials Properties, University of Erlangen-Nürnberg, Germany
NANOINDENTATION AND MICROSTRUCTURAL CHARACTERIZATION OF THERMALLY CYCLED NI-AL-CR BOND COATS ON NI-BASE SUPERALLOYS
20. Markus Krottenthaler
Institute I: General Materials Properties, University of Erlangen-Nürnberg, Germany
IN-SITU TENSILE TESTING AND RESIDUAL STRESS CHARACTERIZATION OF NIAL BOND COATS USED ON NICKEL BASED SUPERALLOYS
21. Christoph Metzner
Fraunhofer Institute for Electron Beam and Plasma Technology, Germany
(FEP) PLASMA-ACTIVATED ELECTRON BEAM VAPOR DEPOSITION - TECHNOLOGIES AND TECHNIQUES
22. Wesley Jackson
University of California, Santa Barbara, USA
OXIDATION AND RUMPLING BEHAVIOR OF β -PHASE BOND COATS
23. Wesley Jackson
University of California, Santa Barbara, USA
DELAMINATION OF CMAS INFILTRATED TBCS UNDER A THERMAL GRADIENT