

# **SUPERALLOYS AND COATINGS**

## ***Materials for Gas Turbines***

**7-10 May, 2019**

**Dr. Donald H. Boone and Prof. Gerhard E. Fuchs**



This 4-day course provides a basic level of knowledge on the metallurgy, manufacturing, mechanical, and surface behavior of these critical gas turbine hot-section alloys and components. Coating performance, selection, and application techniques are also covered, as these technologies are so vital to subsequent repair and refurbishments strategies. Of particular importance is the information on component degradation, remaining life assessment, and repair workscoping.

The next course will be held at the University of Florida (MSE Department), Gainesville, FL, 7-10 May, 2019. Discounts are provided for early registration and groups of 3 or more.



This course, is designed to provide a basis for the engineering, supervisory and purchasing decisions concerning gas turbine equipment operation, and component repair, refurbishment, refitting, and replacement where superalloys are involved. It has been given both publically, and "in-house" to OEM's, utilities, airlines, designers, manufacturers, government agencies, users and repair groups. This course has been presented over 80 times, has become the standard training course of the entire gas turbine industry and has received very strong feedback from students, as seen below.

*"I wish I took this course at the start of my career 15 years ago!"*

*"The materials covered will directly affect our ability to coat product. Our staff is primarily manufacturing based, and the course did well to bridge the technical information to a practice use of the info."*

*"Thanks for allowing us to participate in your amazing superalloy course. In all my career I can't recall a more extensive or useful short course. Your many years of practical experience is evident."*

*"The subject matter was specific to actual materials being processed. The course covered a good understanding of metallurgy & applied coatings."*

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## *Materials for Gas Turbines*

Dr. DONALD H. BOONE and  
Prof. GERHARD E. FUCHS

7-10 May, 2019 University of Florida, Materials Science & Engineering Department  
(Rhines Hall), Gainesville, FL.

### Tentative Schedule

#### TUESDAY, 7 May

08:00 WELCOME & INTRODUCTION Boone & Fuchs  
08:30 Superalloys in Turbine Design Boone  
09:30 BREAK  
09:45 Superalloys for Gas Turbines  
10:30 What Makes Superalloys Strong? Fuchs  
11:45 Processing of Superalloys Fuchs  
  
12:30 LUNCH  
  
01:30 Processing of Superalloys Fuchs  
02:00 Principles of Nickel Base Alloys Fuchs  
03:00 BREAK  
03:15 Principles of Cobalt Base Alloys Fuchs  
03:45 Principles of Ni-Fe Base Alloys Fuchs  
04:30 Metallurgy of the Casting Process Fuchs  
05:30 CLOSE  
  
06:00 Cocktail Hour and Reception

#### WEDNESDAY, 8 May

08:00 Metallurgy of the Casting Process Fuchs  
09:00 Directionally Solidified and Monocrystal Castings Fuchs  
10:00 BREAK  
10:15 Heat Treatment of Superalloys Fuchs  
11:00 What's New, What's Happening Fuchs  
12:00 The Stability of Superalloys Fuchs  
  
12:30 Lunch  
  
01:30 Surface Attack; Oxidation and Hot Corrosion Principles Fuchs  
02:30 Alternative Materials Fuchs  
03:00 BREAK  
03:15 TiAl-Based Alloys Fuchs  
04:00 Degradation of Coatings under Service Conditions Boone  
04:30 CLOSE

#### THURSDAY, 9 May

08:00 Protective Coatings: Introduction Boone  
08:30 Aluminides – Diffusion, Modified and Vapor Phase Boone  
09:30 BREAK  
09:45 Aluminides (cont'd) Boone  
10:45 Overlay Coating Processing Boone  
11:30 Thermal Spray Coatings Processing Boone  
  
12:30 LUNCH  
  
01:30 Thermal Barrier Coating Fuchs  
02:30 BREAK  
02:45 Overlay Coating Compositions Boone  
03:30 Coating Mechanical Property Considerations Boone  
04:30 CLOSE

#### FRIDAY, 10 May

08:00 Coatings, Ranking and Selection Boone  
08:30 Repair & Rejuvenation: Introduction and Considerations Boone  
09:30 R&R Cleaning, Stripping Boone  
10:00 BREAK  
10:15 NDI Techniques Boone  
11:15 Weld and Braze Repair Techniques; Recent Advances & Limitations Boone  
  
12:30 LUNCH  
  
01:30 Component R&R Summary Boone  
02:00 Component Life Assessment, Philosophy & Procedures incl. Case Studies Boone  
03:30 Course Recap, Discussion Fuchs & Boone  
  
04:30 CLOSE

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## *Materials for Gas Turbines*

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This 4-Day course presents a basic level of knowledge of the metallurgy, manufacture, mechanical and surface behavior of these critical turbine hot section alloys. Most importantly, the course also provides strong coverage of coating protection and the technologies vital to repair and refurbishment such as coating stripping and re-coating, welding, brazing, HIPing and re-heat treatment. Thus, a sound working knowledge for the decisions concerning repair, refurbishment, retrofitting and replacement is provided.

Please register the following students for the "Superalloys" 4-Day Course to be given at the University of Florida, Materials Science & Engineering's excellent technical facilities in Gainesville, FL. Information on housing options in the area will be provided, Tuesday through Friday, 7-10 May, 2019. The specific course location along with more specific travel and hotel information will be supplied with reservation confirmation.

NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_ Phone: \_\_\_\_\_  
Fax: \_\_\_\_\_  
e mail: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

CITY: \_\_\_\_\_

STATE/ZIP/COUNTRY: \_\_\_\_\_

4-Day fee, including USB thumb-drive with notes, is \$2,400.00/student; a \$200 discount available until 15 March. There is also a 10% Group discounts for 3 or more students.

Hard copy of the ~1700 pages of notes in 5" 3-ring binder (weights about 10 pounds), available at check in when pre ordered, at a cost \$250.00/copy.

All registrations fees (and payments for hard copies of notes) MUST be paid in full on or before the first day of class, otherwise the student will not be allowed to attend.

Payment accepted for all major credit cards or bank wire transfer information is also available.

Please send registration form and payment to: Gerhard E. Fuchs  
gfuch@mse.ufl.edu  
(352)846-3317



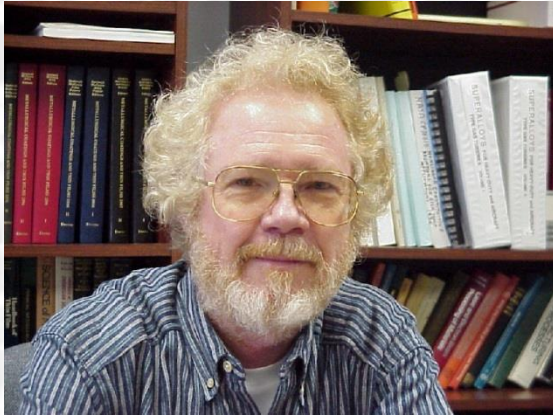
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## ***Materials for Gas Turbines***

### **COURSE INSTRUCTORS**

#### **Donald H. Boone, Ph.D.**

**Industrial Consultant and President of BWD Turbines Limited and Boone & Associates, Inc. His expertise and experience includes the areas of protective coatings and their processing, and the effects of structure on performance for protection and for resulting mechanical properties. In addition, BWD**



**Turbines is involved in the development and installation of coating manufacturing, and repair and rejuvenation facilities including automated welding and advanced brazing techniques. Dr. Boone was previously associated with Pratt and Whitney Aircraft's Advanced Materials Research & Development Lab, Temescal Coatings Div., Lawrence Berkeley Labs of the Univ. Of California, and the Dept. Of Mechanical Engineering Naval Postgraduate School. There he worked on the development, evaluation and processing of high temperature materials and coatings used in modern aircraft and industrial gas turbines. He is a member of several committees active in the area of gas turbine materials application and manufacturing including the Manufacturing, Materials and Metallurgy Committee of IGTI. Dr. Boone has authored over 200 technical publications and holds a number of patents in the high temperature alloy and coatings field.**

#### **Gerhard E. Fuchs, Ph.D.**

**After receiving his Ph.D. in Materials Science from R.P.I in 1986, Dr. Fuchs worked in the aerospace and nuclear power generation industries for 12 years and taught part time at Union College and R.P.I. In 1998, Dr. Fuchs joined the Materials Science and Engineering Faculty at the University of Florida, where his research has focused on the inter-relationship of processing, microstructure and properties of intermetallic alloys, Ni-base alloys and superalloys. Dr. Fuchs continues to work closely with industry, laboratories and other academic institutions and has developed a new graduate-level course on "High Temperature Alloys" and has updated courses on "Advanced Phase Diagrams", "Metallurgical Engineering" and "Process Metallurgy". Dr. Fuchs is active several professional societies, serving on several committees, including the High Temperature Alloys Committee (TMS), Seven Springs International Symposium Committee (TMS) and International Materials Review Editorial Board (ASM) and is also the faculty representative for the TMS/ASM Student Chapter at the University of Florida. Dr. Fuchs has also authored more than 75 technical publications and edited two books in the field high temperature alloys.**

