

# ICOPS 2008

The 35th IEEE International Conference on Plasma Science



## MINICOURSE

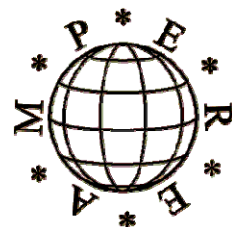
*June 19-20, 2008 • Congress Center Karlsruhe, Germany*

### Microwave Processing of Materials:

- Industrial Microwave Systems
- Waveguides and Transmission Devices
- Avionic and Automotive Applications
- Microwave Chemistry
- Sintering of Materials
- Plasma and Nanomaterials Applications
- Dielectric Measurements
- Electromagnetic Modelling and Simulation

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[www.icops2008.org](http://www.icops2008.org)



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## OVERVIEW

As part of the International Conference on Plasma Science 2008 (ICOPS 2008), a special two-day minicourse on microwave processing technologies will be offered on Thursday June 19<sup>th</sup> and Friday June 20<sup>th</sup>. ICOPS 2008 and the Mini Course will be held at the Congress Center Karlsruhe, Germany. A group of international experts from academia and industry will provide a set of comprehensive lectures on industrial microwave processing and systems, avionic applications, antennas, energy efficient waveguides and transmission devices as well as computational methods.



The course is structured in two sessions. A single session on the first day will cover some fundamentals of microwave processing technologies with a main focus on development, energy efficiency and devices.

The second day will focus on avionic and automotive applications as well as on simulations and dielectric measurements.

### Who should attend

The course is designed for engineers/scientists from industry and research, technicians, and graduate level engineering/science students with an interest in applied

Microwave processing is extremely important for a variety of industrial applications. These include high performance materials used in automotive, aerospace, electronic and medical applications, chemical industry, environmental technologies, as well as advanced materials development and materials processing. This minicourse presents a unique opportunity to learn from leading, international microwave processing experts.

microwave technologies and applications. At the same time, for the audience, the instructors will provide the most current information and will provide laboratory visits on the latest technology developments in their respective areas.



**Mini Course Chair: Dr. Lambert Feher**

*Supported by:*



Forschungszentrum Karlsruhe  
in der Helmholtz-Gemeinschaft



Universität Karlsruhe  
Research University • founded 1825

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## Instructors

**Dr. Lambert Feher**, Forschungszentrum Karlsruhe, Institute for Pulsed Power and Microwave Technology, Germany. Dr. Feher is head of the Industrial Microwave Group and expert on avionic applications, HEPHAISTOS-Technology, Microwave Quantum Materials interaction and industrial processing.

**Dr. Monika Willert-Porada**, Chair of Materials Processing, Faculty of Applied Natural Science, University of Bayreuth, Germany. Dr. Willert-Porada is Professor for Materials Processing, Material Properties and Effects, Glass, Ceramics and Composites.

**Dr. Mototasy Sato**, National Institute for Fusion Science (NIFS), Japan. Dr. Sato is head of microwave and fusion applications and has a great expertise on Industrial Microwave Systems and kilns for ceramics sintering and processing.

**Dr. Rudolf Emmerich**, Fraunhofer Institute for Chemical Technology, Pfinztal, Germany. Dr. Emmerich is expert for Microwave Plasma Technology, Microwave Antennas, Polymers and Composite Curing for naval and automotive applications.

**Dr. Richard Day**, University of Manchester, Microwave Chemistry, UK. Dr Day specializes in the basics of microwave curing of resins and composite materials. He is interested in the effect microwave heating has on the chemistry and the structure of resins. He is also interested in how this affects the properties of laminates made by microwave heating compared to those made using other routes.

**Dr. Jaleel Akhtar**, Forschungszentrum Karlsruhe, Institute for Pulsed Power and Microwave Technology, Germany. Dr. Akhtar is working in the Industrial Microwave Group and specialized on dielectric measurements and simulation of highly conducting materials in the solid and liquid phase.

**Dr. Michael Henningsen**, BASF AG, Germany. Dr. Henningsen is expert on resin components and chemistry; synthesis of novel microwave active hardeners and accelerators, new resin formulations and systems for advanced automotive and aerospace applications.

**Dr. Cristina Leonelli**, University of Modena, Italy. Dr. Leonelli teaches as a professor with specialization on Microwave Simulation and System Design, Glass and Ceramics Processing.

**Dr. José Manuel Catalá Civera**, University of Valencia, Spain. Dr. Catalá Civera is expert on dielectric measurements and probes, system design and simulation and teaches as a Professor for Electrical Engineering and Communication Systems.

**Dr. Dorothée Vinga Szabó**, Forschungszentrum Karlsruhe, Institute for Material Science III, Germany. Dr. Szabo is head of the nanomaterials group and is specialized in Microwave Processing of Nano-Particles and related Microwave Plasmas.



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## ICOPS 2008 Mini Course Schedule

### Session 1: Basics, Components and Technologies June 19<sup>th</sup>, 2008

08.00-09.30	Industrial Microwave Processing Introduction and Overview	Feher
09.30-11.00	Electromagnetic Heating Processing and Material Effects	Willert-Porada
11.00-12.30	Industrial Microwave Systems and Applications in Japan	Sato
12.30-01.00	Lunch	
01.30-03.00	Waveguides, Antennas and Dielectric Sensing	Catalá
03.00-04.30	Microwave Plasma and Polymer Applications	Emmerich

### Session 2: Dielectrics, Chemistry and Application June 20<sup>th</sup>, 2008

08.00-09.30	Dielectric Measurements and Methods	Akhtar
09.30-11.00	Microwave Curing of Resins and Composites	Day
11.00-12.30	Resin Chemistry and Microwave Enhancements	Henningsen
12.30-01.00	Lunch	
01.30-03.00	Microwave Treatment of Ceramics and Glasses	Leonelli
03.00-04.30	Microwave Plasma Processing of Nano-Materials	Szabó
05.00-06.00	Visit to HEPHAISTOS-Experimental Center	Feher

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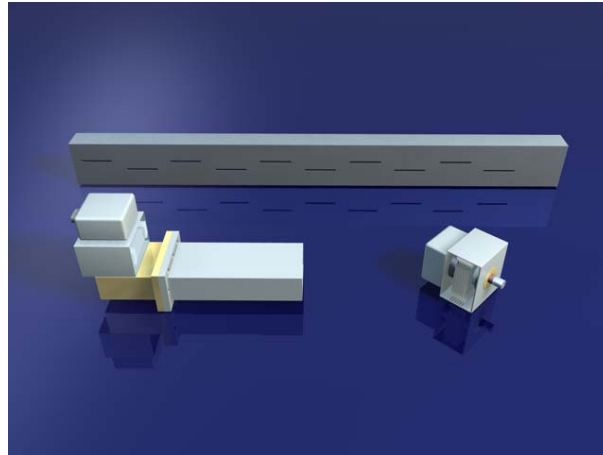
## Courses – Day 1

### Basics, Components and Technologies

The first section of the course targets to explain and demonstrate basics of microwave processing as well as industrial system technologies.

#### Industrial Microwave Processing – Introduction and Overview (Feher)

The instructor will briefly present theoretical basics of electromagnetic propagation, microwave applicators, sources and microwave frequencies, wave material interactions and quantum effects, as well as their concrete application on avionic and automotive technologies based on the industrialized HEPHAISTOS-systems.



beneficially realize the processing of artistic and technical specimens by the use of microwaves. In addition, the microwave interaction in ceramic materials with occurring micro plasmas has been intensively experimentally investigated by the instructors group and recent results will be presented.

#### Electromagnetic Heating, Processing and Material Effects (Willert-Porada)

In this section, the microwave interaction will be focused in detail on materials science and catalytic chemistry for microwave sintered ceramics, glasses, carbon and composite materials. The use and efforts of electromagnetic processing generated by induction, microwaves, infrared and optical lasers as well their combination is discussed as well as their unique material effects and potentially adjustable properties and energy conversion mechanisms.

#### Industrial Microwave Systems and Applications in Japan (Sato)

Ceramics and sintering have been traditionally high arts in Japan. The instructor will present microwave systems, microwave kilns and technologies on an industrial scale that

#### Waveguides, Antennas and Dielectric Sensing (Catala)

The design and manufacturing of tailored waveguides, circulators and system components is essential for an efficient microwave circuit. A systematic overview on active and passive microwave components is given. Simulation tools and their capabilities for system design are discussed and compared. The instructor will present several system applications e.g. for dielectric sensing of materials.

#### Microwave Plasma and Polymer Applications (Emmerich)

In reduced pressurized environments, plasma interactions and heating with microwave happens. The industrial use of this approach is broadly used. The instructor will give an overview on applications and technologies that are involved with the generation of microwave plasmas. In addition, polymer applications and a curing technology for thermosets with radiated microwaves is presented for naval applications.

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## Courses – Day 2

### Dielectrics, Chemistry and Applications

The second section of the course focuses on dielectric materials, measurements, chemical interactions and their applications.

#### Dielectric Measurements and Methods (Akhtar)

The instructor will explain several methods for dielectric measurements as well as their support and representation by simulations. Experimental set-ups are demonstrated. Results for industrial relevant materials and their frequency as well as their temperature dependence are discussed and results for high conducting materials are shown.



(aircraft manufacturing) and automotive structures. The composition and efforts of microwave selective additives to enhance material and process properties are shown.

#### Microwave Treatment of Ceramics and

#### Glasses (Leonelli)

Simulation and system design for industrial ceramic and glass treatment with microwave is essential to develop new and unique solutions to replace conventional ovens and materials. The instructor with great research expertise on oven heating, green microwave chemistry and ceramic processing will show several examples starting from the fundamental research level with microwaves, the computational design state and applicator choice as well as their industrial representation.

#### Microwave Curing of Resins and Composites (Day)

The curing of epoxy, fibre reinforced and thermoset materials with microwaves is very promising for upcoming industrial applications. The instructor will show detailed effects and material enhancements obtained by microwave curing with epoxy matrix systems. Applications and enhancements by chemical additives for aerospace and automotive are intensively discussed.

#### Resin Chemistry and Microwave Enhancements (Henningsen)

This section focuses on chemical reactions for polymers, resin curing and the enhancement and acceleration of these production components by microwave catalysis and additives. The discussed systems are used intensively in aerospace

#### Microwave Plasma Processing of Nano-Materials (Szabó)

The focus of this course is the application of microwaves for the synthesis of nanoparticles. Fundamentals of the Karlsruhe Microwave Plasma Process (KMPP) are explained. The main parameters to influence particle size are outlined. Examples of the synthesized nanomaterials, physical properties and application potentials for industrial use are presented.

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## How to Register

The cost of the minicourse is € 400. For students, there is a reduced rate of € 200. This includes 2 full day instruction from microwave processing experts plus course materials.

It is possible to register for the minicourse exclusively! It is not mandatory to sign up for the ICOPS conference to benefit from the minicourse.

Don't miss this unique opportunity to learn from internationally-recognized microwave processing experts. Register online at the ICOPS 2008 conference website. Registrations accepted through May 31, 2008.

Go to [www.icops2008.org](http://www.icops2008.org) and choose "Registration". Select "Minicourse Registration" under the "Fee Schedule".

If you require more information about the course content, please contact [lambert.feher@ihm.fzk.de](mailto:lambert.feher@ihm.fzk.de)

If you require more information about registration, please contact Martina Huber at [martina.huber@ihm.fzk.de](mailto:martina.huber@ihm.fzk.de)

## Location

The minicourse will be held at the Congress Center Karlsruhe.

To book accommodation for a hotel, mention ICOPS 2008 to benefit from the reduced conference rate. For details on booking accommodation, please visit the ICOPS 2008 website – [www.icops2008.org](http://www.icops2008.org) and click on accommodation/hotel booking link.

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## Getting to Karlsruhe

### Travel by plane

#### Frankfurt Airport

Frankfurt Airport is located directly adjacent to the A 5 motorway, Frankfurt – Karlsruhe. About 1 hour and 15 minutes by car from Karlsruhe. The Deutsche Bahn AG offers rail connections to and from Karlsruhe from Frankfurt Airport and from Frankfurt Main Station. The Deutsche Bahn AG gives information about arrival and departure times.

#### Stuttgart Airport

Stuttgart Airport is situated directly adjacent to the A 8 motorway, Munich – Karlsruhe. About 1 hour by car from Karlsruhe. There is a local rail connection from Stuttgart Airport to Stuttgart Main Station.



### Travel by train

Karlsruhe forms an important junction of the Deutsche Bahn (German national railway) and is situated directly on the ICE (high-speed train) route of Hamburg – Frankfurt – Basel. The east-west axis of Karlsruhe – Stuttgart – Munich starts here.

### Travel by car

Karlsruhe lies directly at the A 5 motorway. The city center is less than ten minutes drive away from the exits for "Durlach" and "Karlsruhe Mitte" either via the Durlacher Allee or the round the southern by-pass.

A routing system – green signs with white lettering – assists new arrivals to find their booked or chosen hotel. In the same way, the parking guide system leads the way to the many multi-story car parks in the city center.



**HEPHAISTOS-Staff**