Fraunhofer ACADEMY

Fraunhofer IFAM

COURSE PROGRAM

TRAINING CENTER FOR FIBER COMPOSITE TECHNOLOGY

5 YEARS SHAPING A STRONGER FUTURE

WWW.BREMEN-COMPOSITES.COM

WWW.IFAM.FRAUNHOFER.DE

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TRAINING CENTER FOR FIBER COMPOSITE TECHNOLOGY
Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
– Workforce Qualification and Technology Transfer –

Parkallee 301
28213 Bremen | Germany

Phone +49 421 2246-402 | Fax +49 421 2246-605
register@ifam.fraunhofer.de

CONTENT

FOREWORD

Multifunctional products and lightweight design are presenting industry with new opportunities for innovation. In many industries, fiber composite materials are playing a vital role here. Key sectors such as shipbuilding, car manufacture, and the aviation and aerospace industries are striving to increase their national and international competitiveness by optimizing the technical training of their personnel.

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM has been a member of the Fraunhofer Academy since 2006. The Training Center for Fiber Composite Technology at Fraunhofer IFAM is fully accredited and offers a range of training courses, with successful participants being awarded internationally recognized certificates. A feature of the courses provided by Fraunhofer IFAM is the direct introduction of the latest research & development results into the training courses.

The training courses provided by Fraunhofer IFAM are part of the TOP program of the Fraunhofer Academy. The courses meet the highest quality standards and are given by highly experienced Fraunhofer experts. You too can benefit from the training courses of Fraunhofer IFAM and gain a vital technical advantage.

Best regards,
Dr. Roman Götter,
Head of the Fraunhofer Academy

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ACADEMY

www.academy.fraunhofer.de

COURSES

TRAINING CENTER FOR FIBER COMPOSITE TECHNOLOGY

This brochure gives an overview of training courses in fiber composite technology offered by the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Bremen, Germany.

The Fiber Reinforced Plastic Manufacturer, Fiber Reinforced Plastic Remanufacturer, Fiber Reinforced Plastic Specialist, and Composite Engineer training courses are available in both German and English. If you would like an In-House training course at your company, then this can be given in German, English, or translated into the relevant local language at any desired location in the world. Please contact us so that we can discuss the necessary arrangements for the relevant course and plan the timing.

The Training Center is accredited and meets the quality requirements of DIN EN ISO/IEC 17024.

New from 2019: Participants who successfully complete training courses in fiber composite technology will receive their certificates from the Fraunhofer Certification Body for Workforce Training. **Read more on Page 17.**

We hope our training courses are of interest and look forward to welcoming you and your colleagues as course participants in the near future.

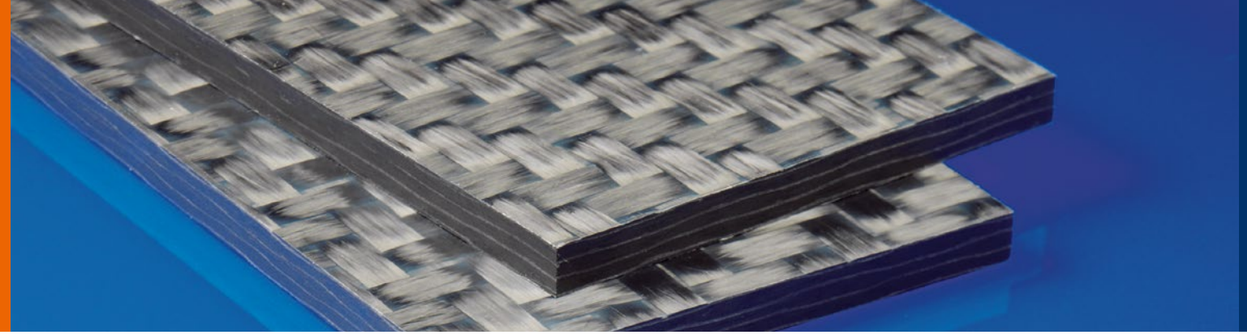
The training team at Fraunhofer IFAM

SHAPING A STRONGER FUTURE

www.bremen-composites.com

Dates, prices and the registration form can be found on the Internet at www.bremen-composites.com or in our event brochure.

FIBER REINFORCED PLASTIC MANUFACTURER (FRP-M)



FRP-M

Objectives of the training course

The Fiber Reinforced Plastic Manufacturer course teaches participants how to manufacture high-quality FRP components using manual production methods. The course focuses on extending and consolidating practical know-how. The theoretical background knowledge required for working with fiber reinforced plastics is acquired via the so-called digital introductory learning program. This is accessed online or via the special Learn-App.

Duration of the training course and examinations

The total duration of the course, including the examinations, is 40 hours (one week). The theoretical content of the digital introductory learning program is an integral part of the course and is required for the formal training course. The course ends with oral and practical examinations on the last day. A prerequisite for taking these examinations is regular attendance at the course sessions.

Target groups and preconditions for participation

The course is aimed at company employees whose work involves handling or fabricating fiber reinforced plastics and at those who wish to enter this technical field. Participants must have an adequate knowledge of the course language to enable them to understand the course material and take the examinations.

COURSE CONTENT

Fundamental principles

The fundamental features of fiber reinforced plastics are largely covered in the digital introductory learning program. This gives participants a basic knowledge of the various components (fibers and matrix materials).

Materials

The course participants learn how the various components of fiber reinforced plastics affect the resulting properties of FRP products. Based on this knowledge, key points for handling FRP materials are highlighted.

Manufacturing methods

The course participants learn theoretical, and in particular, practical aspects of manual manufacturing methods. This covers various components and geometries and also the effective machining of FRP components. The identification and prevention of flaws and defects are discussed.

Health and safety at work and environmental protection

Safety measures to be taken when working with fibers and plastics, and regarding the auxiliary materials which are used in repair and manufacturing processes, are discussed. The proper use of work equipment and protective equipment is also covered.

Further information including details of fees and course dates can be found in the course schedule brochure or on our website: **www.bremen-composites.com**

FIBER REINFORCED PLASTIC REMANUFACTURER (FRP-R)

FRP-R

Objectives of the training course

The course participants will be trained to repair fiber composites and to work in industrial production. The training course teaches employees how to understand and effectively follow work instructions for their particular work tasks. After successful completion of the course they are able to process and repair high-quality fiber composite structures. The course focuses on extending and consolidating practical know-how. The theoretical background knowledge required for working with fiber reinforced plastics is acquired via the so-called digital introductory learning program. This is accessed online or via the special Learn-App.

Duration of the training course and examinations

The total duration of the course, including the examinations, is 40 hours (one week). The theoretical content of the digital introductory learning program is an integral part of the course and is required for the formal training course. The course ends with oral and practical examinations. A prerequisite for taking these examinations is regular attendance at the course sessions.

Target groups and preconditions for participation

The course is aimed at employees in companies whose work involves independently maintaining, repairing, and processing fiber reinforced plastics following work instructions. Participants must have an adequate knowledge of the course language to enable them to understand the course material and take the examinations.

COURSE CONTENT

Fundamental principles

The fundamental features of fiber reinforced plastics are largely covered in the digital introductory learning program.

Materials

This section of the course provides participants with knowledge about the various components (fibers, matrix materials, core materials, fillers) used for manufacturing and repairing fiber reinforced plastics and their effects on the subsequent component properties. Points which must be specially heeded when repairing and maintaining fiber reinforced plastics are also covered.

Repair methods

Effective repair is a prerequisite for subsequently using the repaired components. The participants are introduced to the principles of repair techniques. Besides the necessary preliminary work, various strategies for repairing fiber composite components are introduced and are consolidated in practical assignments. In addition, the identification and prevention of flaws and defects are discussed.

Quality assurance

This section of the training course covers relevant quality assurance measures when repairing fiber reinforced plastics. This includes correct storage and processing of starting materials and also effective surface pretreatment to realize high-quality repairs.

Health and safety at work and environmental protection

Safety measures to be taken when working with fibers and plastics, and regarding the auxiliary materials which are used in repair and manufacturing processes, are discussed. The proper use of work equipment and protective equipment is also covered.

Further information including details of fees and course dates can be found in the course schedule brochure or on our website: **www.bremen-composites.com**

FIBER REINFORCED PLASTIC SPECIALIST (FRP-S)

FRP-S

Objectives of the training course

This course provides training for employees involved in designing fiber reinforced plastics and planning their industrial manufacture. The direct linking of the theoretical and practical sessions means that the participants acquire a fundamental understanding of the effects of the individual components (e. g. fibers, matrix materials, core materials, additives) on the properties of the final FRP components. This practical knowledge is vital for effectively monitoring production processes. The course hence teaches the participants how to select suitable starting materials and manufacturing methods in order to meet the requirements of the resulting FRP products. After successful completion of the course, the participants will be able to select suitable matrix materials to manufacture high-quality FRP components, identify any defects/flaws, and repair these. They also acquire a comprehensive overview of current manufacturing methods and learn the differences between processing thermosets and thermoplastics.

Duration of the training course and examinations

The total duration of the course, including the examinations, is 120 hours and is split into 3 one-week modules focusing on different topics. To aid the learning, the theoretical part is backed up by a large number of practical assignments. The first and second one-week modules finish with written examinations. The final oral and practical examinations take place on the last day of the course. A prerequisite for taking the final examinations is regular attendance at the course sessions and having passed the written examinations at the end of the first and second one-week modules.

Target groups and preconditions for participation

The course is aimed at employees in industry whose work involves planning the manufacture of FRPs and implementation in the process chain, and at employees in companies that want to start manufacturing FRPs. Participants must have an adequate knowledge of the course language to enable them to understand the course material and take the examinations. A professional qualification in fiber composites or plastics or several years' work experience in these areas would be advantageous.

COURSE CONTENT

Fundamental principles

The course starts by covering the fundamentals of fiber reinforced plastics (FRPs). In theoretical and practical sessions the participants learn about the special features of FRPs and their constituent components. The differences between thermoplastics and thermosets are explained as are the typical features and properties of different fiber materials and textile semifinished products.

Materials

In order to adapt the component properties to meet specific requirements, it is vital to have knowledge about all influencing factors and their effects on the final products. The participants learn to estimate the effects of the individual starting materials (matrix, fiber type, textile semifinished product) on the resulting properties of an FRP component and learn to use this findings for production process planning. They also learn that not only the nature of the starting materials has a key effect but also their relative quantities and, for example, the fiber orientation. Optimal laminate structure and component geometry to maximize fiber/matrix interactions are also dealt with.

Manufacturing methods

The participants are introduced to the principles of manual and machine-based production technologies. In addition to hand lay-up, the special features of modern production methods such as vacuum infusion technology, resin transfer molding (RTM), press methods, autoclave technology, and pultrusion are discussed. The effect of the choice of matrix on the FRP production process is covered as are the necessary boundary conditions for production processes. Also discussed is how the production process, as well as the choice of starting materials and laminate structure, can affect the resulting properties of FRP components. In addition, the identification and prevention of flaws and defects are discussed.

FIBER REINFORCED PLASTIC
SPECIALIST (FRP-S)

Repair methods

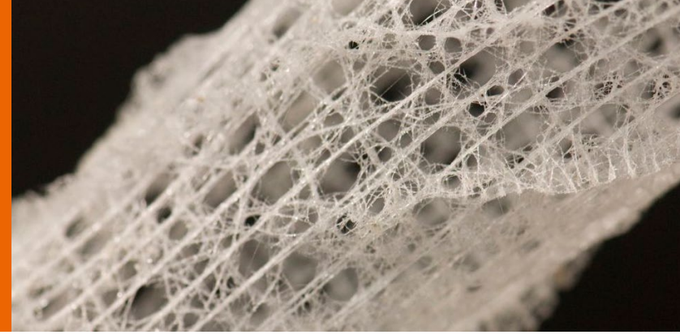
In order to carry out effective repairs it is vital to know the extent of the damage. The course participants learn how to identify typical types of damage to FRP materials and potential sources of the damage. They acquire a basic knowledge of non-destructive and destructive test methods. The course outlines what preliminary work is required for effective repair (e. g. removal of damaged sections, surface preparation). Strategies for repairing fiber reinforced plastic components are explained and these are then consolidated in practical assignments.

Health and safety at work and environmental protection

Safety measures to be taken when working with fibers, plastics, and auxiliary materials are discussed. The proper use of work equipment and protective equipment is also covered.

Further information including details of fees and course dates can be found in the course schedule brochure or on our website: **www.bremen-composites.com**

FRAUNHOFER LIGHTWEIGHT DESIGN ALLIANCE



The Fraunhofer Lightweight Design Alliance is an alliance of 18 Fraunhofer institutes that carry out R&D work on different aspects of lightweight design. The Fraunhofer Lightweight Design Alliance recognizes the challenge of developing technical concepts and solutions in the area of lightweight design and puts the emphasis on developing methods for manufacturing and evaluating lightweight components to ensure they meet safety requirements.

Lightweight design involves the whole development process. Too often lightweight design has been limited to the consideration of individual aspects. Effective lightweight design requires experimentally verified material data and takes into account production and assembly requirements and also recycling aspects. The objective is always to design the form/shape of the structure and materials (form and material based lightweight design) based on known and verified load data and the practical requirements (requirement based lightweight design) such that the component can perform its function/functions and can be manufactured and assembled within the set cost framework. The production process here must be so chosen that the batch numbers, quality, margins, and price allow ideal components to be manufactured (production based lightweight design).

The systematic approach to maximize the potential of lightweight design involves the bundling of expertise along the whole process chain, from the concept phase right through to marketable products.

This approach and philosophy of the Fraunhofer Lightweight Design Alliance is reflected in the Composite Engineer training course that was developed by 14 of the member institutes: The course covers the whole product life cycle of a fiber reinforced plastic component from the development stage to manufacture and repair. The effective use of fiber reinforced plastic technology requires interdisciplinary thought, evaluation, decision-making, and actions. It is imperative that all employees involved in lightweight design are effectively trained!

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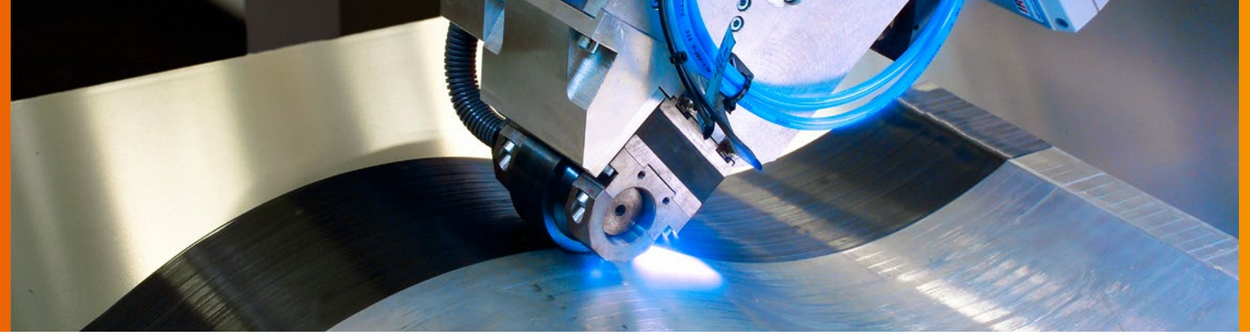
LEICHTBAU

www.leichtbau.fraunhofer.de

COMPOSITE ENGINEER (CE)

MODULAR TRAINING COURSE



CE

Background

Fiber reinforced plastics (FRPs) offer the potential for enormous innovation in many sectors of industry. The new Composite Engineer training course brings together the expertise of the Fraunhofer-Gesellschaft and in particular the Fraunhofer Lightweight Design Alliance in fiber reinforced plastics. The course participants are trained on particular topics by scientists and engineers who are actually engaged in current, cutting-edge R&D work. This guarantees direct transfer of key knowledge and technology to industry.

Target groups and preconditions for participation

The course is aimed at engineers and scientists (technical decision-makers) in all disciplines and sectors of industry who either currently use fiber reinforced plastics or wish to do so in the future. Technicians and technologists with suitable professional experience and expertise are also invited to take the course.

Objectives of the training course

The Composite Engineer course qualifies people to manage the whole life cycle of a fiber reinforced plastic product. This covers product development, manufacture, and repair and involves interdisciplinary thinking, evaluation, decision-making, and actions.

COURSE CONTENT

INTRODUCTORY MODULE (COMPULSORY)

FF **Fundamentals of FRPs**
Overview of the life cycle of a fiber reinforced plastic component

BASE MODULES (COMPULSORY)

CF **Components of FRPs**
Thermoset and thermoplastic matrix systems – fiber types – textile semi-finished products – pre-impregnated textile semi-finished products

MM **Manufacturing methods**
Methods for manufacturing thermoset and thermoplastic FRP components

MF **Machining FRPs**
Separation methods and relevant points to heed – laser beam cutting

JM **Joining methods**
Adhesive bonding – mechanical joining – direct thermal joining – welding – hybrid joining methods

ADVANCED MODULES (4 MODULES TO BE SELECTED)

DC **Design and construction**
Lightweight design – design methods – design guidelines

DM **Design and modeling**
Design, construction, and design/construction philosophies – methods for modeling fiber reinforced plastics and laminates and their transfer to modeling tools (FEM) – modeling strength and damage

MC **Material and product characterization**
Product requirements and classification – damage and failure mechanisms – non-destructive test methods and damage analysis – methods for measuring mechanical parameters (static, cyclic, dynamic, creep)

TT **Testing and test philosophies**
Tests for defects and tests for material properties – typical defects and the importance of non-destructive testing - non-destructive test methods

RR **Repair and recycling**
Repair methods – quality assurance and testing repairs – recycling strategies for FRPs

SD **Structural dynamics and function-integration**
Experimental structural dynamics – simulation models – structure monitoring

VD **Virtual material design**
Image analysis for microstructure characterization – analytical models for material characterization – geometry models – simulation-based material characterization

ST **Surface treatment**
Surface preparation – surface analysis – coating methods

PR **Production technology**
Process chains for production – selection of suitable process routes depending on the materials, processes, design, product requirements, costs / profitability, batch quantities

FINAL MODULE (REVISION AND EXAMINATION)

RE **Revision and examination**

Fraunhofer IFAM is the central registration point for all the modules. The modules are held at a number of different Fraunhofer institutes throughout Germany, so ensuring the course participants have access to the required specialist expertise and equipment required for the various topics*.

On first registration each course participant is issued with access codes for the digital introductory learning program and the associated app that introduce fundamental aspects of the life cycle of a fiber composite component.

The course is in preparation. For up-to-date information, please visit our website **www.composites-bremen.com** from the first quarter of 2019

FRAUNHOFER PERSONNEL CERTIFICATION

From 2019 participants who successfully complete training courses in fiber composite technology will receive their certificates from the Fraunhofer Certification Body for Workforce Training.

The Fraunhofer Certification Body for Workforce Training certifies that the qualifications received by successful course participants are in accordance with the requirements of DIN EN ISO 17024. The certificates confirm that successful course participants have acquired expertise and practical knowledge in the relevant technical area.

Training issues certificates for training courses in Fiber Composite Technology, Usability Engineering, Data Management, and Product Lifecycle Management (PLM).

For further information and the examination regulations please visit our website **www.personenzertifikation.fraunhofer.de/en**

*Subject to change

IN-HOUSE COURSES

FRP-MANUFACTURER
FRP-REMANUFACTURER
FRP-SPECIALIST

For companies who wish to train a larger number of their employees at the same time, there is the option of holding courses at your company. A minimum of 10 participants is required for an In-House training course. The prerequisites for participation, length of the courses, objectives, and course materials are identical to the courses held at the Training Center for Fiber Composite Technology in Bremen.

General requirements for training courses held outside the Training Center for Fiber Composite Technology are as follows:

- If possible, the availability of two separate rooms for theory and practical sessions.
- Theory room with table, flip-chart or whiteboard, including pens, etc.
- Practical room with work benches, adequate ventilation and air extraction, plus facilities for waste disposal. If agreements are made, production areas can also be used for the practical sessions.

All equipment and consumables (such as resins, hardeners, fibers, etc.) required for the practical sessions must be made available by the host company/organization in consultation with the Training Center for Fiber Composite Technology. In consultation with the company/organization, certain aspects of the course can be tailored so that they have relevance to specific production-related issues.

To arrange a date for a course please contact the relevant course organizer.

For specially customized courses for which a qualification cannot be awarded, participants receive a Certificate of Participation.

IN-HOUSE COURSES IN GERMANY AND OTHER COUNTRIES

If you would like an In-House training course at your company, then this can be given in

- German,
- English, or
- translated into the relevant local language at any desired location in the world. Please contact us to discuss the necessary arrangements for such a course and plan the timing.

CONTACT

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM – Adhesive Bonding Technology and Surfaces –

Wiener Strasse 12 | 28359 Bremen | Germany
Phone +49 421 2246-402
www.ifam.fraunhofer.de

Workforce Qualification and Technology Transfer

Parkallee 301 | 28213 Bremen | Germany
Phone +49 421 2246-402 | Fax -605
www.bremen-composites.com

If you any questions about registering for the course, then please contact

Michaela Müller
Training Center for Fiber Composite Technology
Phone +49 421 2246-431 | Fax -605
register@ifam.fraunhofer.de

The Institute

Head: Prof. Dr. Bernd Mayer

Workforce Qualification and Technology Transfer

Head: Prof. Dr. Andreas Groß
Phone +49 421 2246-437 | andreas.gross@ifam.fraunhofer.de

Course venues

– Training Center for Fiber Composite Technology –
Head: Beate Brede
Phone +49 421 5665-465 | beate.brede@ifam.fraunhofer.de
Parkallee 301 | 28213 Bremen | Germany
www.bremen-composites.com

– Training Center for Adhesive Bonding Technology –
Head: Dr. Erik Meiß
Phone +49 421 2246-632 | erik.meiss@ifam.fraunhofer.de
Wiener Strasse 12 | 28359 Bremen | Germany
www.bremen-bonding.com

TEAM WORKFORCE QUALIFICATION AND TECHNOLOGY TRANSFER

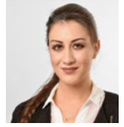
Prof. Dr. Andreas Groß
Head of Workforce Training and Technology Transfer
Phone +49 421 2246-437
andreas.gross@ifam.fraunhofer.de

Dr. Heiko Bauknecht
Tutor at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-7410
heiko.bauknecht@ifam.fraunhofer.de

Dr. Effi Baumgarten
Tutor at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-465
effi.baumgarten@ifam.fraunhofer.de

Volker Borst
Deputy Head of the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-480
volker.borst@ifam.fraunhofer.de

Beate Brede
Head of the Training Center for Fiber Composite Technology
Phone +49 421 5665-465
beate.brede@ifam.fraunhofer.de



Aydanur Demiraran
Administration
Phone +49 421 2246-402
aydanur.demiraran@ifam.fraunhofer.de

Dr. Èric Hernández Edo
Tutor at the Training Center for Fiber Composite Technology
Phone +49 421 5665-484
eric.hernandez.edo@ifam.fraunhofer.de

Dr. Tanja Eggerichs
Tutor at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-7408
tanja.eggerichs@ifam.fraunhofer.de

Lolita Grunska
Tutor at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-7426
lolita.grunska@ifam.fraunhofer.de

Claas Hoffmann
Head of Practical Training at the Training Center for Fiber Composite Technology
Phone +49 421 5665-461
claas.hoffmann@ifam.fraunhofer.de

Milan Kelch
Tutor at the Training Center for Fiber Composite Technology
Phone: +49 421 5665-462
milan.kelch@ifam.fraunhofer.de

Dr. Erik Meiß
Head of the Training Center for Adhesive Bonding Technology | Deputy Head of Workforce Training and Technology Transfer
Phone +49 421 2246-632
erik.meiss@ifam.fraunhofer.de

Michaela Müller
Head finance and controllung
Phone +49 421 2246-431
michaela.mueller@ifam.fraunhofer.de

Dr. Maike Niermann
Administration / IT-Support
Phone +49 421 2246-569
maike.niermann@ifam.fraunhofer.de

Klaus-Dieter Schnabel
Tutor at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-421
klaus-dieter.schnabel@ifam.fraunhofer.de

Stefan Simon
Deputy Head of the Training Center for Fiber Composite Technology
Phone +49 421 5665-456
stefan.simon@ifam.fraunhofer.de

Petra Theuerkauff
Head of Practical Training at the Training Center for Adhesive Bonding Technology
Phone +49 421 2246-463
petra.theuerkauff@ifam.fraunhofer.de

Sibylle Wellbrock
Administration
Phone: +49 421 2246- 258
sibylle.wellbrock@ifam.fraunhofer.de

Dr. Tanja Warratz
PR and Marketing
Phone +49 421 2246-616
tanja.warratz@ifam.fraunhofer.de

FRAUNHOFER ACADEMY

Fraunhofer IFAM is a founding member of the Fraunhofer Academy

Handling new technology and new methods and processes wants to be learned. If current research knowledge is to unfold its innovative potential in companies, smart minds with the relevant know-how are needed. The Fraunhofer Academy, the consortium of all Fraunhofer Institutes with a focus on advanced training, provides the necessary qualification for specialists and managers. It is the expert supplier for advanced training on the job. Specialists and managers profit from a unique knowledge transfer flowing from Fraunhofer Research to the companies. The "knowledge generators" simultaneously act as "knowledge transmitters".

What started out as a project, has developed into a well established and renowned institution of the German education and training landscape.

Since the founding the Fraunhofer Academy has continually grown. In the beginning phase the academy comprised the activities of four Fraunhofer Institutes offering one program each, today 17 facilities are responsible for 25 programs in five thematic areas:

- Technology and Innovation
- Energy and Sustainability
- Logistics and Production
- Production and Testing Technology
- Information and Communication

Due to the close co-operation with industry and businesses, Fraunhofer knows the current technical as well as social challenges and turns research results into usable innovations in an efficient and targeted way. This up-to-date knowledge from experience is reflected in the course offers of the Fraunhofer Academy.

For further information about the Academy's program
www.academy.fraunhofer.de/en.html