

The background is a vibrant blue with abstract, glowing wireframe graphics. A large, semi-transparent wireframe face is positioned in the center, looking towards the left. To the left of the face are several glowing wireframe spheres of different sizes, some connected by thin lines. In the bottom right corner, there are large, interlocking wireframe gears. The overall aesthetic is high-tech and futuristic.

# Profile of Fraunhofer IFAM Applied Materials Research and Manufacturing Technologies

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**Technology Transfer for a Sustainable Future**



# Contents

|  |           |
|--|-----------|
| <b>Applied Research in Trusted Partnership with Industry and Society</b> | <b>3</b>  |
| Core Competencies  | 5         |
| Our Range of Services  | 7         |
| <b>Core Competencies</b>   |           |
| Metallic Materials   | 8         |
| Polymeric Materials  | 9         |
| Surface Technology   | 10        |
| Adhesive Bonding   | 11        |
| Shaping and Component Manufacturing                                      | 12        |
| Energy Storage and Converters  | 13        |
| Automation and Robotics  | 14        |
| <b>Workforce Qualification and Technology Transfer</b>                   | <b>15</b> |
| <b>Business Units</b>  | <b>16</b> |
| Aviation   | 17        |
| Energy   | 18        |
| Mobility   | 19        |
| Maritime Technologies  | 20        |
| Medical Technology and Life Sciences                                     | 21        |
| <b>Effective Collaboration across Fraunhofer</b>                         | <b>22</b> |
| <b>Locations</b>   | <b>23</b> |

# Applied Research in Trusted Partnership with Industry and Society

## The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft, based in Germany, is a leading applied research organization. It plays a crucial role in the innovation process by prioritizing research in key future technologies and transferring its research findings to industry in order to strengthen Germany as an economic hub as well as for the benefit of society.

As an important customer group, small- and medium-sized companies in particular tap into Fraunhofer's expertise and resources to develop new technologies and maintain their competitiveness. For years, Fraunhofer has been one of the most active patent applicants in Germany and Europe. The research organization is therefore developing an extensive, international patent portfolio in various technology sectors, primarily as a basis for transferring technology through research projects, spin-offs and licensing. In this way, Fraunhofer experts support industry partners from ideation to market launch, and Fraunhofer's interdisciplinary and international collaboration in specific market environments addresses social objectives in important technology areas. Fraunhofer also promotes research into key technologies that are vital for society as a whole by applying specific, interdisciplinary and international collaboration geared to the needs of the market. Examples include technologies for the energy transition, cybersecurity and underlying models for generative artificial intelligence.

Fraunhofer is an attractive and established party for public-private partnerships and also makes a significant contribution to strengthening Germany as a hub for innovation and ensuring its viability in the future. Its activities create jobs in Germany, boost investment effects in the private sector and increase the social acceptance of new technology. International collaboration projects with excellent research partners and companies across the globe ensure that the Fraunhofer-Gesellschaft remains in direct contact with the most prominent scientific communities and economic areas.

Founded in

1949

75

Institutes

Around

32,000

employees

3.6 billion €

Research volume



Founded in  
**1968** Part of the  
Fraunhofer-Gesellschaft  
since 1974

**7** Locations  
in Germany  
Around  
**730**  
employees

Total budget  
**73.6** million €

### Fraunhofer IFAM

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM is one of Europe's leading independent research institutes in the fields of Adhesive Bonding Technology, Surfaces, Shaping and Functional Materials.

At our seven institute locations in Bremen, Dresden, Stade, Wolfsburg, Braunschweig, Helgoland and Cuxhaven, we focus on key technologies and the sustainable transfer of our research findings to future-relevant industries such as Mobility, Energy, Aviation, Maritime Technologies, Medical Technology and Life Sciences.

Over 730 employees pool their broad technological and scientific expertise in the core competencies: Metallic Materials, Polymeric Materials, Surface Technology, Adhesive Bonding, Shaping and Component Manufacturing, Automation and Robotics, and Energy Storage and Converters. These core competencies – both individually and in combination – are the basis of the institute's strong position in the research market and form the basis for innovative solutions.

The spectrum of our contract research is comprehensive and ranges from materials to shaping and joining technology, as well as the functionalization of surfaces, the development of complete components or complex systems, and current issues relating to energy systems and digital transformation and its practical implementation. In this regard, Fraunhofer IFAM covers the entire value chain from material development to product design and integration into industrial manufacturing – including pilot production, quality assurance procedures, and targeted measures for personnel qualification in modern technologies.

### Hand in Hand for Solutions

The institutes of the Fraunhofer-Gesellschaft cooperate in different networks and pool their expertise in flexible structures. To jointly develop solutions for specific business units, Fraunhofer IFAM is part of the MATERIALS and Energy Technologies and the Climate Protection Fraunhofer Groups. In addition, it is also organized in various alliances, in particular the AVIATION & SPACE Alliance and the Fraunhofer Academy.

## Core Competencies

Fraunhofer IFAM is a materials science research institute with a focus on metallic and polymer materials. The broad technological and scientific know-how is bundled in seven core competencies. These are based on many years of development work, sound knowledge and experience as well as continuous adaptation and further development in response to changes in the specific field. They form the basis for future-oriented developments.



■ Metallic Materials



■ Polymeric Materials



■ Surface Technology



■ Adhesive Bonding



■ Shaping and Component Manufacturing



■ Energy Storage and Converters



■ Automation and Robotics

Process-oriented workforce qualification or training as well as specific technology transfer is offered for all core competencies.

### Scientifically Validated and Quality-assured

Expert knowledge, numerous years of experience and advanced equipment – these are the foundations for the successful, practice-oriented processing of customer-specific issues.

In addition to the strong application orientation, which is visible in projects with partners from a wide range of industries, scientific excellence in our core competencies is also a guiding principle of the institute.

The intensive cooperation and networking with universities and higher education institutions at the institute's locations play a significant role at Fraunhofer IFAM. Numerous members of staff engage in teaching as professors or lecturers. Depending on the location, our institute directors are appointed to chairs at the University of Bremen or the Technical University of Dresden. This ensures a close connection to basic scientific

research and promotes the successful transfer of the latest research results into practice. International contacts and collaborations support this process.

The quality management at Fraunhofer IFAM ensures the quality of our work and creates the basis for continuous improvement of processes. Parts of the institute are certified according to DIN EN ISO 9001 as required. In addition, certain divisions are recognized according to DIN EN ISO/IEC 17024 or accredited according to DIN EN ISO/IEC 17025 including the Nadcap standard for laboratories.

Through our research, we contribute to sustainable development in the sense of an ecologically intact, economically successful and socially balanced world. We feel committed to this responsibility.



### Committed to You

We understand our customers and know the challenges they face today and tomorrow. Together, we develop holistic solutions for their long-term success. In direct discussions, we address the specific requirements with flexibility and attention to detail. Subsequently, we define tailored solutions for each project and put together the corresponding project team.

Thanks to the synergies at Fraunhofer IFAM, we can quickly, efficiently, and solution-oriented address complex issues of our clients, whether industry- or product-related. The range of R&D services extends from feasibility studies to a market-ready concept or product. Additionally, we offer technology and know-how transfer as well as corresponding personnel qualification.

### Expertise in Navigating New Technologies

Fraunhofer IFAM has decades of experience in professional training. For industrial users, there is an extensive range of courses on the topics of adhesive bonding technology, fiber composites and electromobility. The technologies developed at the institute can then be applied or implemented in operational practice.

The range of further training courses are particularly interesting for companies in the transportation and plant engineering sectors, electromobility, energy technology, adhesives and fiber composites, as well as in the packaging, textile, and electronics industries, and microsystems and medical technology.

## Our Range of Services

- Technical market studies
- Feasibility studies / Benchmarking
- Experimental R&D services
- Material development and process qualification
- Technical and economic component studies for new products
- Development of new components and products with special combinations of properties and functions
- Development and optimization of manufacturing processes
- Process simulation and development
- Process qualification and quality assurance
- Assessment of production processes
- Plant engineering and plant construction
- Material and component testing
- Failure/damage analyses
- Materialography and analytics
- Technology transfer and employee training for newly developed processes
- Workforce qualification and quality assurance





# Core Competence Metallic Materials

## Technology Spectrum

### Materials

- Sintered and composite materials
- Metal foams and cellular metals
- Composite materials, multi-material composites
- Light metals
- Materials for tribological applications
- Materials for energy conversion and-storage (thermoelectrics, magnetocalorics, latent heat storage)
- Magnetic materials
- Electrode materials
- Functional coatings
- Metal hydrides for reversible hydrogen storage

### Manufacturing

- Powder metallurgy
- Metal injection molding (MIM)
- Additive manufacturing
- Casting technologies
- Printing technologies
- Materialography and analytics

Metallic and metal-based materials form the backbone of industrial production. With the development of innovative products and manufacturing methods, the demands placed on material properties and performance are steadily increasing.

A central focus in the field of metallic materials is the in-depth understanding of microstructure–property relationships and their targeted optimization through advanced manufacturing technologies. Powder metallurgical processes, for instance, offer exceptional possibilities for designing sintered and composite materials with customized properties and diverse combinations.

By blending powders, materials can be engineered to meet specific property profiles. Parameters such as hardness, toughness, modulus of elasticity, wear resistance, and thermal expansion can be precisely adjusted to fulfill the exact needs of a given application.

The Casting Technology Department processes a broad spectrum of casting materials, including aluminum, magnesium, zinc, copper, steel, and custom special alloys. In addition, the development and optimization of metal-matrix composites (MMCs) for casting applications play a key role in meeting light-weight construction demands – especially in transport technology, where light metals and cellular materials contribute significantly to weight reduction.

Research activities also focus on materials designed for hydrogen production and storage, thermal management and thermoelectric generators, energy technologies and alternative drive systems. Key topics are high-temperature and magnetic materials.

These developments address critical challenges in emerging technologies and energy systems, supporting sustainable progress across industries.

*Screen-printed stator and rotor plate  
of an electric motor*



# Core Competence Polymeric Materials

## Technology Spectrum

### Raw material development

- Adhesives
- Composite materials
- Coatings
- Potting compounds
- Recyclable and switchable systems
- Renewable raw materials

### Analysis methods

- Reaction processes
- Material characterization
- Rheology
- Thermal analysis

### Manufacturing

- Additive manufacturing
- Prototyping
- Characteristic value determination
- Function and service life
- Machining technology
- Quality assurance



*Plastic patch made from dynamic polymer networks*

The relevance of polymer and polymer-modified materials has increased in recent years due to their variable and unique properties and potential to conserve resources.

Novel polymer materials are opening technically interesting perspectives in the application of adhesives, potting compounds, composites and coatings. In addition to petrochemical-based materials, the focus is on renewable raw materials that are either organic- or CO<sub>2</sub>-based or are obtained from recycled materials. These materials can be specifically adjusted for technical applications. Another research focus is on reactive polymers with extensive expertise in the area of thermosets and elastomers.

The spectrum of expertise is comprehensive and ranges from material development, processing, formulation, material and component characterization to approaches for repair, recycling and material circularity for plastics and composites.

It is characterized by a holistic and unbiased approach along the entire value chain from the molecule to the component.

Quality assurance is the comprehensive competence element, which is essential for optimizing specific manufacturing processes for new polymer materials and its generated components. Quality assurance at Fraunhofer IFAM is supported by a certified personnel qualification program, which includes targeted technology transfer.



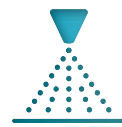
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metallic-materials](http://www.ifam.fraunhofer.de/metallic-materials)



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polymeric-materials](http://www.ifam.fraunhofer.de/polymeric-materials)







## Core Competence Surface Technology

### Technology Spectrum

#### Process and production technologies

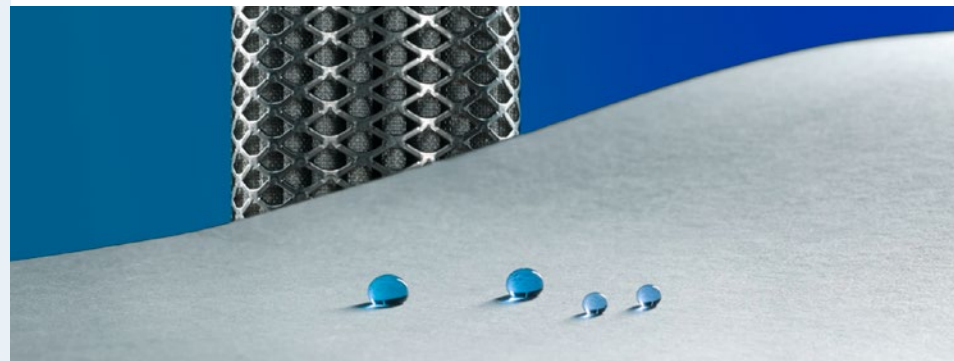
- Plasma and laser technology
- Blasting process
- Wet and dry chemical surface pre-treatment
- Anodizing processes, micro-arc oxidation
- Coating processes and application technology
- Digital and mask-based printing processes
- Monitoring of surface properties
- Drone applications in surface technology

#### Development focus

- Functional coatings: corrosion protection, adhesion promotion, fluorine-free release and anti-stick coatings, barrier layers, anti-fouling (passive, active), fouling-release, ice-repellent layers, and antiviral / antibacterial coatings
- Testing and evaluation of sealants
- Particle treatment
- Sensing of surfaces and components
- Local heating structures

#### Equipment

- Surface analysis
- Electron microscopy
- Applied inspection and test methods
- Accredited corrosion tests
- Tribometer, abrasion and erosion tests
- Center for Networked Surface and Coating Technology
- Icing wind tunnel
- Helgoland test field (outdoor weathering / mole / underwater test field)
- Research vessel Joseph von Fraunhofer
- Drone launch site in Cuxhaven



*Hydrophobic, fluorine-free plasma coating on a plastic fleece*

Fraunhofer IFAM is committed to developing innovative functional coatings and sustainable surface processes, whether the emphasis is on utilizing renewable raw materials for advanced technical applications or on eliminating hazardous substances such as fluorine-containing materials (PFAS) in consumer products. These solutions aim to meet both technical requirements and environmentally friendly standards.

The properties of materials and components can be optimized through targeted surface treatment so that, for example, they can withstand hydrogen at low temperatures and high pressures, resist corrosive loads in fuel cells or effectively prevent fouling and deposits.

The spectrum of work ranges from material and process development to industrial application processes, supported by the characterization, testing and evaluation of relevant material and component properties. At the same time, the possibilities for AI-supported evaluation of laboratory data and control of processes in surface technology are taken into account and utilized. The main areas of work include the development of wet and dry chemical cleaning and pre-treatment processes as well as coating processes ranging from plasma technology and painting processes to application and printing processes, always considering modern quality assurance aspects in production monitoring.

In addition, the characterization and evaluation of surfaces through chemical, electrochemical and structural analyses provide valuable information about their nature, properties and quality, supported by computer-aided simulation methods as well as robust inspection and testing options.



## Core Competence Adhesive Bonding

Over the past decades, adhesive bonding has become widely adopted across various industries and continues to create new areas of application. Fraunhofer IFAM is regarded as the leading international, independent research institution for adhesive bonding. For more than 50 years, highly skilled and multidisciplinary teams at Fraunhofer IFAM have been advancing this versatile joining technology. The holistic approach, extensive experience, diverse technical specialization of the staff, and wide range of equipment enable efficient and high quality services as well as research and development contracts.

The core competence of Fraunhofer IFAM includes the careful selection of adhesives, the comprehensive characterization of mechanical properties, the analysis of the processing properties of adhesives, the design and validation of bonded structures and the development and application of dispensing and application processes. It also includes quality assurance, the detailed design of customer-specific industrial processes and the systematic analysis of cases of damage and production faults and their prevention. The portfolio includes challenges such as adhesion promotion, high-temperature applications and ageing protection are just as much a part of the portfolio as rapid curing and hybrid joining. Economic and ecological sustainability aspects like debonding and deassembly of bonded joints are considered across the various process chains.

A long-established, extensive and internationally offered portfolio of workforce qualification in adhesive bonding technology with qualifications recognized throughout Europe is an essential part of our quality assurance concept for adhesive bonding technology. Providing our customers with intensive and comprehensive advice on all aspects of adhesive bonding technology is a matter of course for us.

*Digitized and automated adhesive application*



### Technology Spectrum

#### Adhesive selection

- Preparation of specifications
- Selection and characterization of adhesives, sealants and potting compounds
- Pasty adhesives and adhesive tapes
- Flow behavior, thermomechanics and mechanics
- Electrically/optically/thermally conductive contacts

#### Adhesive bonds

- Accredited material testing
- Design of bonded joints
- Verification of bonded structures
- Numerical material simulation
- Crash and fatigue behavior
- Long-term durability of bonded joints
- Hybrid joining: Bonding plus hemming, riveting, clinching
- Fiber composite components, lightweight and mixed construction design

#### Manufacturing processes

- Material-adapted surface pre-treatment
- Automated dosing, mixing and application technology
- Production planning, process design, automation
- Coatings on flat substrates
- Production and testing of bonded prototypes

#### Quality assurance

- Process reviews and failure analyses
- Process audits, operational testing in accordance with DIN EN 17460 (DIN 6701) and DIN EN ISO 21368 (DIN 2304)
- Inline process control for substrate and adhesive / non-destructive testing



**Find out more**  
[www.ifam.fraunhofer.de/  
surface-technology](http://www.ifam.fraunhofer.de/surface-technology)



**Find out more**  
[www.ifam.fraunhofer.de/  
adhesive-bonding](http://www.ifam.fraunhofer.de/adhesive-bonding)







# Core Competence Shaping and Component Manufacturing

## Technology Spectrum

### Material development

- Sintered and composite materials
- Cast materials
- Porous metallic materials
- Functional materials
- Composite materials (polymer-filler composites)
- Material and design simulation

### Shaping processes

- Additive manufacturing processes (LBM, EBM, binder jetting, 3D screen printing, moldJet, FDM, LMM)
- Powder metallurgy (pressing and sintering, powder injection molding)
- Casting (die casting, low-pressure casting, investment casting, hybrid casting and gigacasting)
- Compounding and extrusion process injection molding process

The core competence Shaping and Component Manufacturing comprises the development and optimization of shaping manufacturing technologies, including the production of prototype components and parts. Decades of research have provided Fraunhofer IFAM with in-depth expertise in materials and materials science. This knowledge, combined with a wide range of industrial shaping processes, enables a continuous process chain from material selection to the finished component.

The focus of the development work is on processes for non-form materials such as powders and melts. Technologies such as metal powder injection molding and casting processes are used, as well as state-of-the-art additive manufacturing technologies, where components are created tool-free from powdered materials in almost any shape and complex forms directly from CAD files.

Virtual product development and simulation of shaping processes are an integral part of the project work. There is a strong emphasis on the customer-specific development of products and components for a diverse range of application areas particularly automotive, aviation, energy, and life sciences. In this context, Fraunhofer IFAM places particular emphasis on technology areas such as battery and storage technology, electric drives, vehicle bodies and aircraft construction. In all development steps, the overarching goal is to significantly enhance the energy efficiency and sustainability of the shaping processes developed and the materials used.

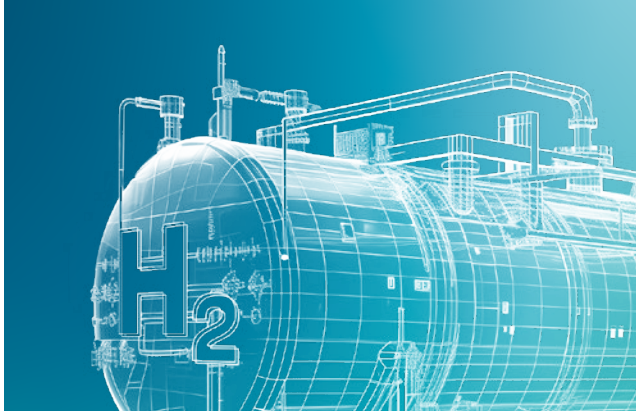
*Low-pressure casting system*



**Find out more**  
[www.ifam.fraunhofer.de/  
shaping-component-manufacturing](http://www.ifam.fraunhofer.de/shaping-component-manufacturing)



# Core Competence Energy Storage and Converters



## Technology Spectrum

### Electrical energy storage

- Battery cell chemistry: Li-, Na-, Zn-systems paste development and electrode production
- Cell construction and cell design
- Sustainable battery production, reduced CO<sub>2</sub> footprint
- Solid-state batteries
- Intelligent battery aging determination: physical modeling & AI-based methods

### Battery recycling

- Energy-efficient, water-based electrochemical processes with high selectivity for the recovery of Li, Co, Ni, Cu
- Efficient electrochemical water desalination
- Desalination battery

### Hydrogen technology

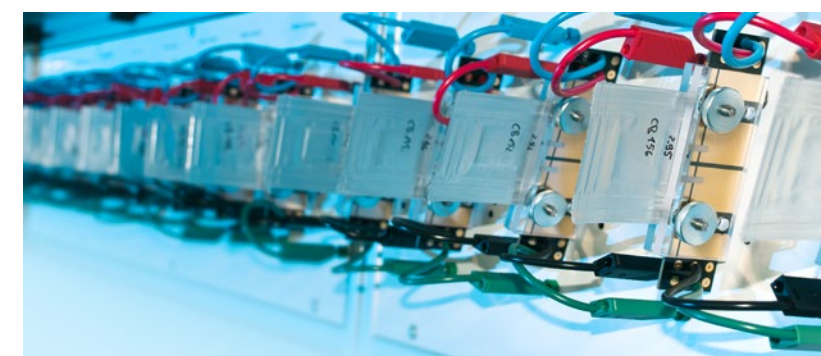
- Hydride technology (hydrogen storage, compression, purification)
- Stack component qualification for electrolysis
- Electrode development for electrolysis
- Simulation of the electrolysis process
- Development and qualification of electrolysis concepts

### Thermal energy storage

- Efficient, highly dynamic latent heat accumulators

### Energy systems

- Analyses, potential studies, and consulting
- Energy-efficient buildings and districts
- Combined heat and power generation
- Piped heat supply
- Digital heat demand maps
- Energy efficiency in materials/process technology
- Housing industry and electromobility
- System integration of stationary/mobile storage systems



*Test system for battery materials*

Fraunhofer IFAM's core competence Energy Storage and Converters are dedicated to electrochemical processes used to store electrical energy or to convert electrical energy into chemical energy and vice versa. In addition to the material and process engineering aspects, scientific analyses of energy systems in the section of energy and heat supply are also considered.

Current challenges involve safely storing electrical energy while simultaneously achieving high energy and power density, high efficiency, and a long lifespan at low costs. The safe and efficient solid-state batteries developed at Fraunhofer IFAM offer a promising solution to this. Additionally, intensive research is underway on alternative battery materials, such as cobalt-free lithium-ion as well as sodium and zinc-ion systems. Another key focus is the electrochemical recovery of raw materials like lithium and cobalt from aqueous media, particularly for the battery recycling process.

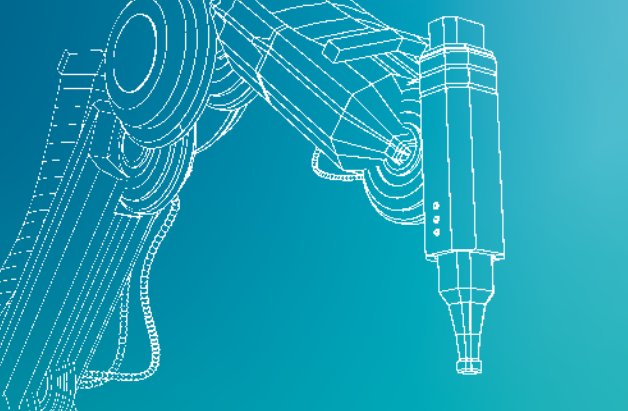
Determining the state of health of batteries is a crucial factor in assessing their performance and service life. New methods that allow quick and reliable assessments are being developed as part of various research projects.

Hydrogen as an energy carrier is also crucial for the success of the energy transition. In the field of hydrogen and fuel cell technology, the institute places particular emphasis on the efficient further development of alkaline electrolysis (AEL and AEMEL) and the storage of hydrogen. To this end, innovative materials, manufacturing technologies, and system components are developed regarding efficiency, durability, robustness, and cost.

**Find out more**  
[www.ifam.fraunhofer.de/  
energy-storage-converter](http://www.ifam.fraunhofer.de/energy-storage-converter)







## Core Competence Automation and Robotics

### Technology Spectrum

- Acquisition, evaluation, and visualization of measurement data
- Development of plants and plants components
- Sensor-guided robots with high positioning accuracy
- Precise robots on linear axes or autonomous ground vehicles
- Assembly up to large structures on a 1:1 scale
- Joining technology: bonding, shimming, sealing
- Surface technology: pre-treatment, coatings
- Printing machining technology: milling, drilling, water jet cutting
- Additive manufacturing and functional printing
- Quality assurance of manufacturing processes, materials, material composites and coatings
- Drone-based maintenance, inspection, and servicing processes

In addition to the diverse research activities in materials science and manufacturing, the core competence Automation and Robotics further enhances the expertise provided by Fraunhofer IFAM. The focus is primarily on processes that need to continuously and precisely adapt to loosely tolerance or changing components, variable production processes, or human work contributions. To meet these requirements, Fraunhofer IFAM also develops and optimizes high-performance robotic systems, such as industrial robots. The drone research, focusing on the development of components, systems, and procedures for maintenance, inspection, and repair processes, represents another area of expertise.

This core competence fosters the development of comprehensive automation solutions for technologies such as joining, sealing, surface treatment, machining, and printing, as well as the associated technological environment. Solutions for comprehensive quality assurance in manufacturing processes, materials, material combinations, and coatings are also developed through innovative methods for capturing, evaluating, and visualizing measurement data, interconnected processes, and the use of intelligent materials.

The automation solutions from Fraunhofer IFAM aim to increase the effectiveness and efficiency of manufacturing and repair processes, improve sustainability, ergonomics, and workplace safety in production, optimize the product lifecycle through quality and condition monitoring, enhance product quality, and reduce process costs.

For these development activities, a 4,000 square meter research hall provides space for process and plant development up to large scale, accommodating components and structures that can exceed twenty meters in length.

*Assembly system for aircraft fuselages with flexible holders for adjusting the shape and position of large components*



## Workforce Qualification and Technology Transfer

Innovative technologies and materials can only be successfully implemented in practice if their operational users are qualified to use them. Personnel training is a crucial aspect of the technology transfer process ensuring the latest scientific findings and methods are effectively integrated into safe industrial applications.

Fraunhofer IFAM offers a variety of opportunities for knowledge transfer. To ensure the professional use of adhesives and fiber reinforced plastics (FRPs), employees must be properly trained. The adhesive bonding courses European Adhesive Bonder, European Adhesive Specialist, and European Adhesive Engineer, as well as the FRP courses Fiber Reinforced Plastic Manufacturer, Fiber Reinforced Plastic Specialist, Fiber Reinforced Plastic Remanufacturer and Composite Engineer (in collaboration with the Fraunhofer Lightweight Design Alliance) are specially tailored to meet the needs of different target groups and are offered both as in-person sessions and in a blended learning format. Each course includes a practical part to reinforce the knowledge acquired.

All courses mentioned are an integral part of the following QA standards: Bonding technology – DIN 6701 / DIN EN 17460 (rail vehicle construction) / DIN 2304-1 / DIN EN ISO 21368 (general industry) and fiber composite technology – DIN SPEC 35255.

Latest findings from science and research are also incorporated into the curriculum of the Training Center for Electromobility. The modular three-level seminar series on electromobility offers a qualification program for beginners, advanced learners, and specialists. The transfer reference takes place through direct communication between the scientists and the participants. The practice-oriented qualification is complemented by laboratory exercises.

Fraunhofer IFAM also offers the European Battery Business Club (EBBC), a unique learning platform that combines cutting-edge knowledge of battery technology in the form of online training with an interactive community. Participants can expect engaging industry insights and the latest research findings. The asynchronous online training, consisting of short micro-learning elements such as videos, podcasts, quizzes, and interactive graphics, enables flexible learning – whenever, wherever and at any pace that suits the individual needs.

In addition, we apply research knowledge in our seminar series on “Functional printing”, “Additive manufacturing” and “Hydrogen applications in mobility”. We offer practical, theory-based, and manufacturer-neutral learning content.



### Training Center for Adhesive Bonding Technology

### Training Center for Fiber Composites Technology

- Training courses in adhesive bonding technology
- Training courses in fiber composite technology
- Quality assurance in adhesive bonding technology
- Quality assurance in fiber composite technology

### Technical Qualification and Consulting

### Training Center for Electromobility

- Electromobility seminar series
- Electromobility expert
- Training program “Hydrogen applications in mobility”
- European Battery Business Club (EBBC)
- Additive manufacturing
- Functional printing

### Find out more

[www.weiterbildung.ifam.fraunhofer.de/en.html](http://www.weiterbildung.ifam.fraunhofer.de/en.html)  
[www.qualifizierung.ifam.fraunhofer.de/en.html](http://www.qualifizierung.ifam.fraunhofer.de/en.html)





# Business Units

Business Units

## Aviation

In the aviation business unit, Fraunhofer IFAM develops technological solutions for aircraft manufacturers and their supply chains. With decades of experience in industrial research projects as well as nationally and European funded programs, it manages the central office of the Fraunhofer Alliance AVIATION & SPACE in Bremen, coordinates cross-institute collaboration with leading industry players and is internationally recognized.

Air traffic in Europe must be climate-neutral and sustainable throughout the entire value chain by 2050. Fraunhofer IFAM is supporting this transition through research, ranging from new materials and manufacturing technologies to digitalization and automation. All developments are focused on a lifecycle-oriented aircraft design that is geared towards the circular economy and eco-efficiency in all aspects.

Another approach to decarbonization of aviation is the use of hydrogen as an energy carrier. Key topics include the automated production of fuel cells, the manufacture of hydrogen tanks and bonded structures for cryogenic application. For example, the institute has developed solutions for hydrogen barrier coatings.

Due to continuing cost pressure, manufacturers are seeking ways to automate their manufacturing processes more extensively. Therefore, a key area of development at Fraunhofer IFAM is the automation of processes that must continuously and precisely adapt to low-tolerance or changing components, variable production processes, or human labor contributions.

For this purpose, Fraunhofer scientists use mobile robotic units including linear axes or ground vehicles, that collaborate not only with each other but also with actively forming and shaping component fixtures.

- Digital transformation and automation
- Functional surfaces, paints, and coatings
- Functional printing
- Aviation-specific surface treatment, plasma, and bonding technology
- Process automation in production and assembly
- Quality assurance
- Recognized as an independent testing laboratory in accordance with the NADCAP system required by the aviation industry



Find out more  
[www.ifam.fraunhofer.de/aviation](http://www.ifam.fraunhofer.de/aviation)





# Energy

With its technical expertise in energy system analysis, materials science and manufacturing technology, Fraunhofer IFAM is making a significant contribution to advancing the energy transition. Central elements for progress include the comprehensive planning of the energy system and its components, the development of new materials, material combinations and joining processes as well as the application of efficient manufacturing processes and production chains that meet the technical and economic requirements of modern energy technology. Pioneering developments in renewable energy, electrical and thermal energy storage, as well as hydrogen and the circular economy, are promoted by the Energy business unit. From feasibility studies to the development of market-ready concepts and products, the institute offers customized solutions, complemented by specific testing and validation options.

- Research services for energy producers and suppliers, battery producers, hydrogen economy, onshore and offshore wind energy
- Sector coupling analyses, local and district heating concepts, energy supply and climate protection concepts, electric mobility, energy systems and heat planning
- Adhesive bonding and surface technology for the wind and solar industry
- Recyclable materials and (adhesive-)processes
- Electrolysis and fuel cell research, hydrogen storage (pressurized storage, cryogenic storage, and metal hydrides)
- Hydrogen laboratories for component and system testing
- Electrical energy storage systems, cell development
- Thermal energy storage systems



**Find out more**  
[www.ifam.fraunhofer.de/energy](http://www.ifam.fraunhofer.de/energy)



# Mobility



Sustainable and efficient mobility for both people and goods are a key driver in industry and research. Current challenges in the mobility sector include economic viability, emission reduction, resource conservation and the promotion of a circular economy. Fraunhofer IFAM offers technical and conceptual solutions through a comprehensive understanding of materials, shaping processes, and joining concepts, as well as the complementary integration of relevant competencies. Developments range from process and component levels to a systemic approach that links various forms of mobility and the corresponding infrastructure. In the research projects, mobility concepts for land, water, and air are developed, based on conventional, electric, or hybrid systems. Additionally, the necessary energy supply and storage solutions as well as operational models are developed and implemented in collaboration with project partners.

- Development of electric and hybrid drive systems
- Components for electric drives and their design
- Lightweight solutions
- Battery development from cell chemistry to the hydrogen storage system
- Cast- and powder-manufactured components, especially for complex and lightweight metal components
- Components made from polymer materials (FRP)
- Bonding and hybrid joining, especially for new materials, joining of different materials
- Process automation in production (bonding, machining, coatings, surface functionalization, sensors)



**Find out more**  
[www.ifam.fraunhofer.de/mobility](http://www.ifam.fraunhofer.de/mobility)





## Medical Technology and Life Sciences

In the field of Medical Technology, Fraunhofer IFAM leverages its comprehensive expertise to support manufacturers of implants, instruments, medical adhesives and to coating service providers. In the Life Sciences, the focus of research is on functional materials and biosurface engineering. In addition to materials and coatings, the manufacturing processes are also developed to ensure that the products achieve the required performance and effectiveness while meeting high quality standards. When developing materials and surfaces, product-specific, normative, and technical requirements – such as biocompatibility, degradation behavior, chemical, physical, mechanical, and morphological characterization – are considered and implemented from the beginning.

Furthermore, Fraunhofer IFAM has laboratories to conduct tests on the antibacterial and antiviral effectiveness of surfaces using real-time PCR testing.

- Degradable metallic and polymeric biomaterials and composites
- Biofunctional surfaces to control cell adhesion
- Active surfaces and materials against bacteria and viruses
- Adhesives for medicine and medical engineering
- Cellular metallic materials
- Powder injection molding, additive manufacturing
- In-vitro characterization, in particular biocompatibility, immune response, cell growth, antimicrobial effect
- Biomechanical and degradation tests (static, dynamic, under simulated physiological conditions)
- Surface analysis (XPS, FTIR, FIB-REM, TEM, ToF-SIMS, QCM-D)

## Maritime Technologies

In the field of Maritime Technologies, Fraunhofer IFAM combines its expertise in research areas such as coatings for corrosion and biofouling protection, functional surfaces, lightweight construction, and adhesive bonding technology. The development processes are supported by analytical methods and quality assurance throughout the entire manufacturing chain.

In addition to research activities in the pilot plants, Fraunhofer IFAM offers testing and inspection facilities under realistic environmental conditions on the offshore island of Helgoland. Extensive investigations for corrosion and

biofouling protection, as well as aging studies on material samples, can be conducted in various maritime zones, such as the permanent immersion zone, the tidal zone, the splash zone, and under atmospheric weathering.

Furthermore, the institute focuses on research into the use of drones in the offshore sector at its Cuxhaven location with the Offshore Drone Campus Cuxhaven (ODCC). The available infrastructure with a runway enables the testing of unmanned aerial vehicles for flights over the river Elbe, the North Sea, and beyond.

- Surfaces: Pretreatment, cleaning, activation, analysis
- Functional paints and coatings
- Corrosion protection and electrochemistry
- Lightweight construction and adhesive bonding production
- Quality assurance

### Maritime Technologies Test Center on Helgoland

- Maritime robotics
- Test rigs for long-term testing under offshore conditions

### Offshore Drone Campus Cuxhaven (ODCC)

- Safe and reliable use of drones in the offshore sector



**Find out more**  
[www.ifam.fraunhofer.de/  
maritime-technologies](http://www.ifam.fraunhofer.de/maritime-technologies)



**Find out more**  
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medical-technology](http://www.ifam.fraunhofer.de/medical-technology)





# Effective Collaboration across Fraunhofer

The Fraunhofer-Gesellschaft has consistently structured its organization around research groups. Flexible networking of expertise and capacities enables the institutes to meet very comprehensive project requirements and develop complex system solutions. The Fraunhofer Group MATERIALS pools the expertise of the Fraunhofer-Gesellschaft's institutes specializing in materials science.

Fraunhofer's materials research covers the entire value chain from the development of new materials and the improvement of existing ones to manufacturing technology on an industrial scale, the characterization of properties and the evaluation of application behavior. The same applies to the parts made from these materials and their behavior within systems. In all these areas, numerical simulation and modeling methods are used alongside experimental investigations in laboratories and pilot plants. In terms of materials, the Fraunhofer Group MATERIALS covers the entire section of metallic, inorganic-non-metallic, polymeric materials and materials produced from renewable raw materials as well as semiconductor materials. In recent years, hybrid materials and composites have gained particular importance.

Fraunhofer IFAM also is a guest member of the Fraunhofer Group for Energy Technologies and Climate Protection. The group is the platform for the strategic orientation of Fraunhofer energy research.

In contrast to groups with institutes in related fields, Fraunhofer alliances involve institutes with different areas of expertise collaborating on specific business units. Fraunhofer IFAM is actively involved in numerous alliances. Within the Fraunhofer AVIATION & SPACE Alliance, Fraunhofer IFAM heads the Aviation central office in Bremen. The alliance is an association of 37 Fraunhofer institutes that conduct applied research in the sectors of aviation and space.

Thanks to the extensive technological expertise of the institutes involved, customers benefit from a unique technological spectrum.

### Fraunhofer Groups

- Fraunhofer Group Materials, Components – MATERIALS
- Fraunhofer Group for Energy Technologies and Climate Protection (guest institute)

### Fraunhofer Alliances

- Production
- AVIATION & SPACE
- Batteries
- Chemistry
- Energy
- Transportation

### Fraunhofer Academy

- Advanced training courses

## Locations

### Institute directors

Prof. Dr. Bernd Mayer  
(Executive director)

Prof. Dr.-Ing. Thomas  
Weißgärber

### Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM

Wiener Strasse 12  
28359 Bremen  
Phone +49 421 2246-0  
info@ifam.fraunhofer.de  
www.ifam.fraunhofer.de

Winterbergstrasse 28  
01277 Dresden  
Phone +49 351 2537-300  
info@ifam-dd.fraunhofer.de

Ottenbecker Damm 12  
21684 Stade  
Phone +49 4141 78707-101  
info@ifam.fraunhofer.de

Hermann-Blenk-Strasse 43  
38108 Braunschweig  
Phone +49 421 2246-137  
info@ifam.fraunhofer.de

Hermann-Münch-Strasse 2  
38440 Wolfsburg  
Phone +49 421 2246-227  
info@ifam.fraunhofer.de

Hafenstrasse 1086  
27498 Helgoland  
Phone +49 421 2246-7376  
info@ifam.fraunhofer.de

Albert-Ballin-Platz 1  
27472 Cuxhaven  
Phone +49 421 2246-7429  
info@ifam.fraunhofer.de

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