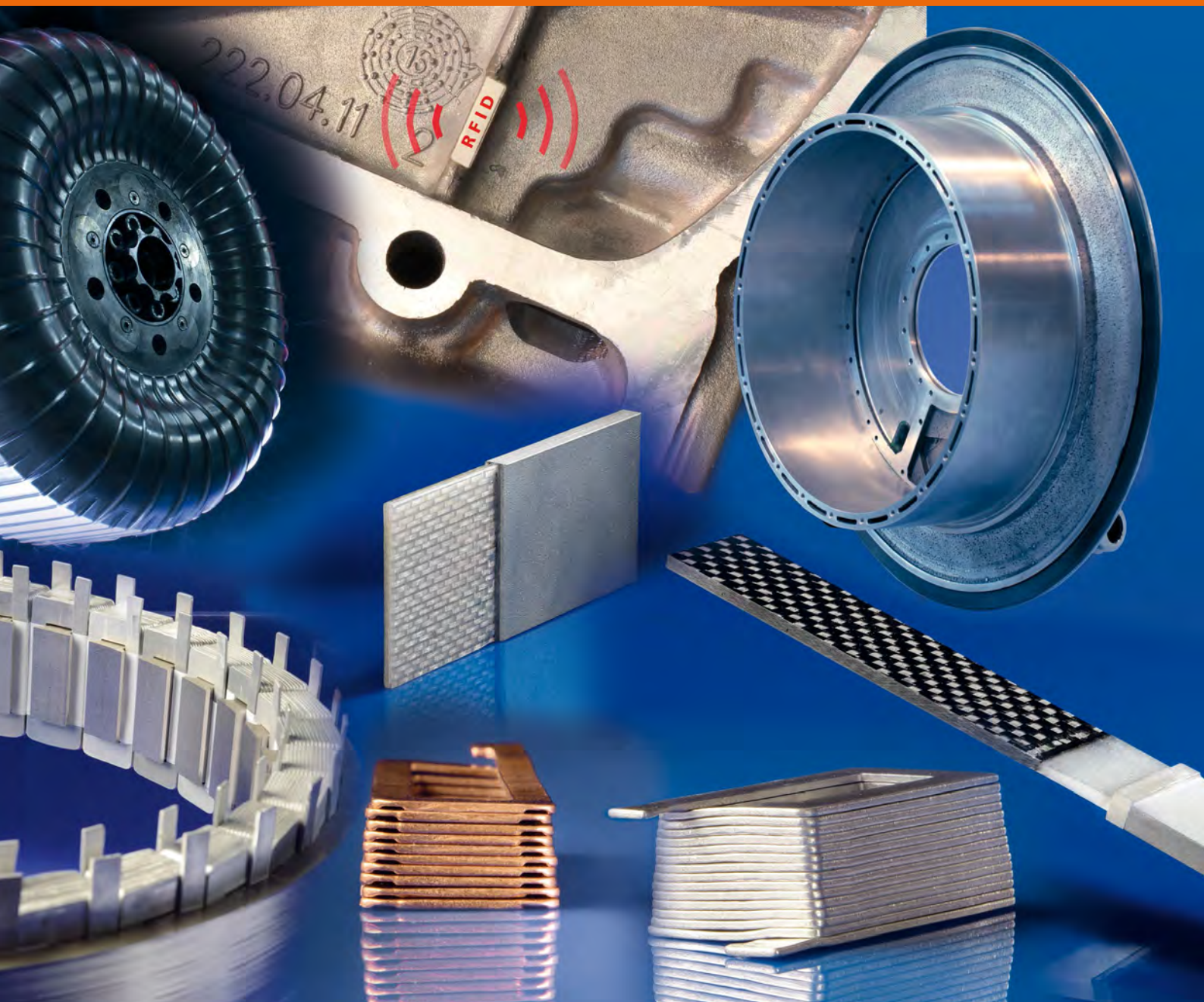
Fraunhofer
IFAM

FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY AND ADVANCED MATERIALS IFAM

CASTING TECHNOLOGY

FROM IDEAS TO PRODUCTS



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WE UNDERSTAND MATERIALS

THE FRAUNHOFER-GESELLSCHAFT

The Fraunhofer-Gesellschaft promotes and carries out applied scientific research and development work. Founded in 1949, the work of the Fraunhofer-Gesellschaft is geared to the needs of industry and society. Our contract partners and customers are companies in the manufacturing and service sectors as well as public organizations. The Fraunhofer-Gesellschaft currently operates 66 institutes in Germany and employs more than 24,000 people, most of whom are scientists and engineers.

The institutes of the Fraunhofer-Gesellschaft also work together: They collaborate in groups and alliances and, depending on the needs of particular projects, they are also able to bundle their expertise in flexible structures. The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM is involved in ten alliances, the Fraunhofer Group for Materials and Components – MATERIALS, and the Fraunhofer Academy.

FRAUNHOFER IFAM

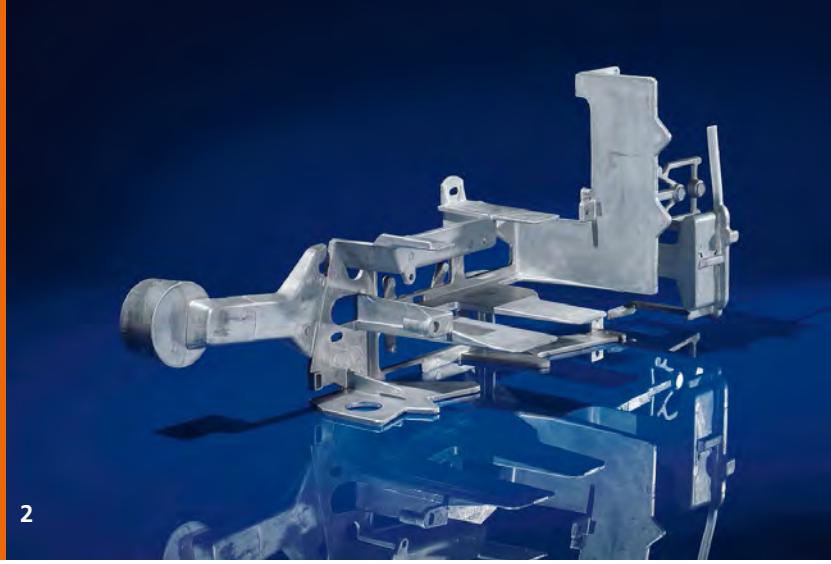
Fraunhofer IFAM is one of the leading independent research organizations in Europe in the fields of "Adhesive Bonding Technology and Surfaces" and "Shaping and Functional Materials". The focus of all the R&D activities is to provide customers with effective, application-oriented solutions. Most of the products, processes, and technologies we develop are for sectors where sustainability is particularly important, namely for the aviation industry, automotive sector, energy and environment, medical technology and life sciences. The solutions developed at Fraunhofer IFAM are, however, also used in various other branches of industry including machinery and plant construction, electronics and electrical engineering, shipbuilding, rail vehicle manufacture, the packaging industry, and the construction sector.

Fraunhofer IFAM has a highly qualified workforce of more than 600 people, organized into project teams and business segments covering specific topics. These topics include materials, shaping, joining technologies, surface functionalization, and the development of complete components and complex systems. This means that Fraunhofer IFAM covers the whole value-creation chain from the development of materials and product design up to the integration into industrial production – including pilot trials and customized workforce training in new technologies.

CORE COMPETENCIES

Fraunhofer IFAM is a material science research institution with an emphasis on metallic and polymeric materials. We have focused our extensive scientific knowledge and technological expertise in seven core competencies. Each of these core competencies – either by itself or all together – are the cornerstones of our success in the R&D market and the basis for future innovations.

- **Powder technology**
- **Sintered, composite, and cellular metallic materials**
- **Adhesive bonding technology**
- **Surface technology**
- **Casting technology**
- **Electrical components and systems**
- **Fiber reinforced plastics**



CASTING TECHNOLOGY

From ideas to products

With our core competence Casting Technology, the Fraunhofer IFAM supports industrial clients in transforming an idea from first prototype to ready-to-use product through casting. As a research and development partner for applied industrial research, we can provide the correct service, whether through technical feasibility studies, consultancy, prototype manufacture, examination of commercial viability considerations, or fault and process analysis. Fitting different issues Fraunhofer IFAM provides several casting processes and materials. Different casting methods and materials are available to suit every application. As well as our many years of experience, important elements of this core competence include the process and systems technology established at Fraunhofer IFAM for high pressure die casting and low pressure casting, lost foam, investment and sand casting, as well as our numerical simulation, comprehensive analysis and materials testing.

Going beyond the classic issues of casting technology, we also help our clients find solutions to their interdisciplinary production and materials engineering requirements. Here, project teams from a variety of disciplines, such as composite materials, powder technology and adhesive bonding technology and surfaces, work together to find scientific and application-oriented answers to questions of corrosion, surface treatment, painting or adhesive bonding. This allows us to develop completely new combinations of technologies and material applications.

1 *Foaming of casting models for the lost foam casting process.*

2 *High pressure die casting part with complex geometry.*

Apart from providing advice on casting technology and customized projects, our research is also focused on the following key aspects:

- **Hybrid casting and fiber integration**
  CFRP-aluminum hybrid casting
  Integration of fiber and wire reinforcement structures into castings

- **Complex castings**
  Salt cores and lost core technologies
  Lost foam and investment casting for the production of highly complex geometries

- ***CAST*TRONICS® – RFID marking for castings and sensor integration**
  Marking of castings using RFID transponders
  Structural health monitoring through sensor integration

- **Components for electric machines**
  Cast coils
  Castings for electric motors

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1

CASTING TECHNOLOGIES FOR CUSTOMIZED CASTINGS

Using state-of-the-art casting equipment, our scientists and technologists develop customer-specific solutions. Flexible team structures combining a wide range of technology competencies are an important factor for our success in developing innovative cast products and reaching new market segments. Here, we pursue new approaches, optimizing our classic casting technology even further through the integration of functions, whilst constantly keeping in mind the demands of industrial production and the need to conserve resources.

The casting pilot plant at Fraunhofer IFAM provides a wide range of casting processes that can be flexibly applied. An availability of industrial series production scale is typical at Fraunhofer and offers the best preconditions for the successful completion of research and development projects. The materials cast include aluminum, magnesium, zinc, copper, steel and special customized alloys. Furthermore, we also develop and improve special materials such as metal-matrix composites, hence opening up new fields of application for casting processes and castings. Numerical simulation of the casting processes and comprehensive analysis round out the competencies.

High pressure die casting

High pressure die casting (HPDC) is characterized by very high productivity and reproducibility. At Fraunhofer IFAM, HPDC cold chamber technology is available for this. In addition to conventional castings, parts with permanent and lost cores – for example salt cores – are developed, fiber, wire and CFRP structures are integrated using the hybrid casting process, porous materials such as ceramics are infiltrated with metal alloys and RFID transponders for the marking of castings are directly cast into the parts.

Low pressure casting

During low pressure casting, the melt is fed laminar under controlled conditions, allowing the production of castings which the highest quality demands, with reduced porosity and without oxide inclusions. The flexibly configurable low pressure casting plant at the institute allows a wide array of different alloys, such as aluminum, magnesium, cast iron, steel and copper, to be cast into different mold materials such as steel dies or sand and ceramic molds. Indirect inductive heating also enables individual special materials, such as salt mixtures, to be cast.

Lost foam

Lost foam technology enables complex parts to be cast directly to near-net shape in one piece. This complexity is achieved by joining polymer foam segments to form a lost-casting pattern, allowing complex castings with internal cooling ducts or complicated undercuts to be produced. During the casting process, the thermal energy of the melt decomposes the pattern material and fills the resulting voids in the mold, producing a cast which is true to detail. Our lost foam casting pilot plant – unique in Europe – offers the full process chain for the production of casting models by rapid prototyping or near-series foaming, through to the casting of aluminum, steel, cast iron or special customised alloys for research and development projects. This allows the development of new castings (e.g. engine housings with complex cooling ducts) as well as the production of prototypes and functional specimens right up to pre-production series. Fraunhofer IFAM is a leading research partner in lost foam technology and works closely with the industry through the association named Lost Foam Council e V.

Investment casting

The production of particularly demanding and filigreed structures with high-quality surfaces is possible using investment casting. At Fraunhofer IFAM, wax models for investment casting can be produced by wax injection molding or rapid prototyping. The models are subsequently fitted with a gating system, formed in ceramic or plaster-based bedding compounds and melted – thus creating the precision mold in a block molding process. Various investment casting plants are available for casting on which various, for example aluminum and copper-based, alloys, but also special alloys and pure metals can be cast.

Sand casting

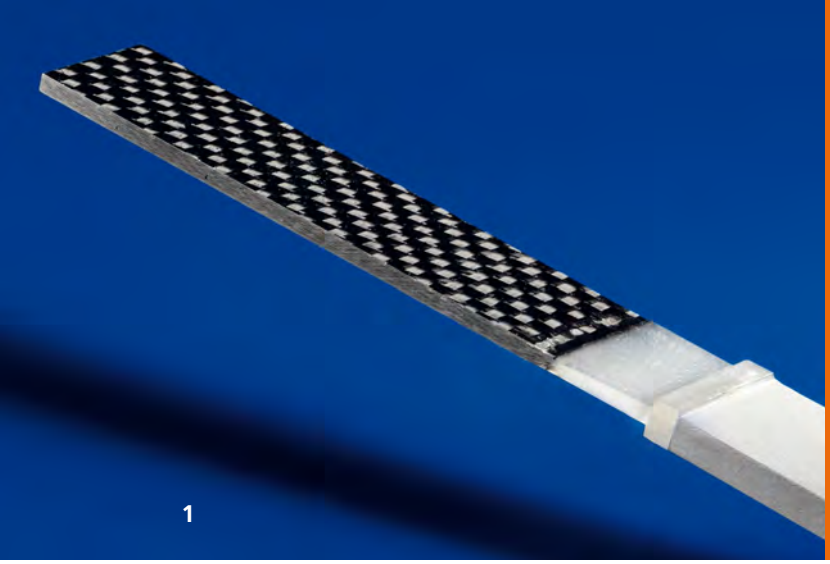
Sand casting is carried out through a hand-molding process. It is suitable for a wide variety of geometries, from simple to complex, thanks to its use of lost cores. Wooden or metal models are used for mo ld production.

→ **www.ifam.fraunhofer.de/casting**

1 *Firing of casting molds for investment casting using the block molding process.*

2 *Casting of steel melts by sand casting with sand cores (© sorapolujjin/Fotolia).*

3 *Bühler SC N/66 cold chamber HPDC machine in the casting pilot plant at Fraunhofer IFAM (© GFG/Thomas Kleiner).*



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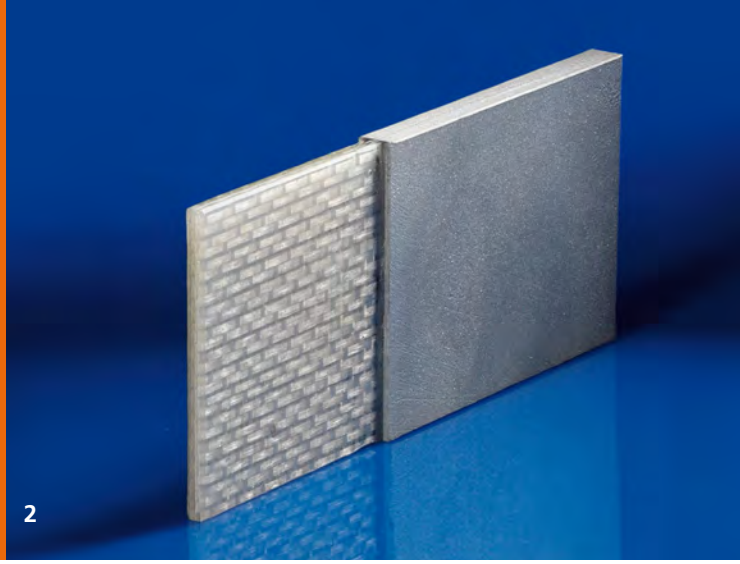

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HYBRID CASTING AND FIBER INTEGRATION

CREATING BONDS AND INCREASING MECHANICAL STRENGTHS

"Hybrid casting and fiber integration" deals with the material integration of fiber and wire structures into castings in order to optimize and influence their mechanical properties, and the joining – by casting – of fiber composites and cast metal, in particular CFRP with cast aluminum. The challenges here lie both in the positioning and fixing of the fiber and wire intermediates in the casting mold, the infiltration behavior and the necessary application of a preload, and in the achievement of a substance-to-substance bond between the cast metal and the fiber or wire structure. Fiberglass structures are generally used to join the casting and fiber composite. Mechanical properties are preferably optimized using fiber structures to increase rigidity or by means of wire structures to improve fracture behavior and fail-safe behavior in the event of damage.

Hybrid casting of CFRP-aluminum composites

In line with the latest lightweight construction developments, demand is growing for highly integrated lightweight structures and new concepts for multi-material design. Joining technology for castings that incorporate different types of lightweight material plays a particularly important role here. New solutions for different types of joint between two such lightweight materials, aluminum and CFRP, are being developed at Fraunhofer IFAM. A transitional structure of glass fibers or heat-resistant plastic between the aluminum and CFRP materials to be joined forms a connection between the metal and the fiber composite material, while taking account of fiber-compatible design and allowing a galvanic decoupling between the CFRP and aluminum materials in order to avoid electrochemical corrosion effects. Compared with conventional joining techniques, this offers the benefits of a reduced installation space and at the same time lower weight. In the event of damage to the fiber composite part, the cast metallic connection areas can be easily separated, and the fiber composite part can be easily replaced using the metallic connecting elements.

Fiber integration

The integration of reinforcing fibers is an established technology for increasing mechanical properties, such as tensile strength or rigidity, in the molding of plastics. Working on this basis, Fraunhofer IFAM is developing processes suitable for series production for the integration of glass, ceramic or carbon fibers into castings directly during casting. The fibers can thereby be integrated into the whole casting or only locally into selected areas. The particular challenges here lie in the application-specific choice and design of the fiber system, so as to ensure an optimum bond between the fibers and the casting matrix, and the exact positioning of the fibers in the casting mold and in the later casting.

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Wire reinforcement

A method for improving the mechanical properties of light alloy castings for highly stressed components has been developed in cooperation with the "Cellular Metallic Materials" department. Local integration of 3D wire structures into the casting can significantly improve not only the high-temperature strength, but also the impact resistance and the fracture behavior of aluminum and magnesium castings, with only a slight increase in density. The resulting increase in mass-specific material properties allows an adapted fail-safe function to be incorporated in the casting. Both the wire reinforcement materials used and the mesh sizes can be significantly varied so that the properties of the castings can also be flexibly adapted to the application. The main challenges facing the integration of reinforcing structures are ensuring the optimum substance-to-substance bond between the reinforcing structure with the casting matrix and ensuring that the right choice of the materials used.

Functional integration – cast embedding of inlays

The term "functional integration" refers to the integration by casting of small parts or connecting elements such as sleeves, tubes, threaded inserts or studs. The challenges for successful integration directly into the casting lie in the positioning of the inlay in the casting mold, automation of the preparation and feed of the inlays and ensuring a positive, non-positive or substance-to-substance bond with the casting matrix.

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1 *CFRP-aluminum hybrid bond with fiberglass laminate integrated into aluminum by casting as a transitional material.*
2 *Ceramic fiber-aluminum hybrid bond produced by aluminum high pressure die casting.*
3 *Reinforced light alloy by integration of 3D wire structures.*
4 *Microsection of a hybrid casting matrix with infiltrated glass fibers produced by aluminum high pressure die casting.*

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2

COMPLEX CASTINGS

THE RIGHT CASTING PROCESS FOR ANY GEOMETRY

At Fraunhofer IFAM, we are developing technologies to allow the production of castings with complex geometries that could not be produced by casting in the conventional manner due to poor demoldability, complicated undercuts or integrated hollows.

Lost cores – hollows without slide gate technology

One major research topic is the development of **lost cores (non-permanent cores)**. With casting methods such as high pressure die casting, gravity die casting or sand casting, complex geometries can only be produced using lost cores. High demands are placed on these cores, particularly those used in high pressure die casting. These include the need for high strength so as to withstand the casting process undamaged. At the same time the cores have to be easy to remove from the cast part afterwards. Fraunhofer IFAM is developing new methods for the production of lost cores made from a variety of materials and for use in different casting processes.

One possibility here is the use of cast **salt cores**, which are strong enough to withstand even the high pressure die casting process thanks to their high thermal and mechanical stability. In the Casting Technology competence field, we are developing new methods of producing salt cores by casting, as well as customized salt mixtures for improving casting and mechanical properties. Prototypes and functional specimens for salt cores are available, as is the planning and conducting of pilot series. Furthermore, we are pursuing innovative technologies for core production in which no melting of the salt mixtures is necessary.

The main research focus in the "lost cores" field addresses the key aspects:

- Development of alternative production methods and materials for lost cores
- Production of salt cores using the low pressure casting, lost foam and die casting processes
- Casting simulation of cast salt cores
- Characterization of salt cores (casting properties, microstructure, mechanical testing, pore analysis, shrinkage properties)
- Casting of salt cores using different metal casting methods
- Technologies for dissolving and removing the cores

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1 *Salt cores of different salt mixtures produced by die casting.*
2 *Examination of salt cores in the bending test.*

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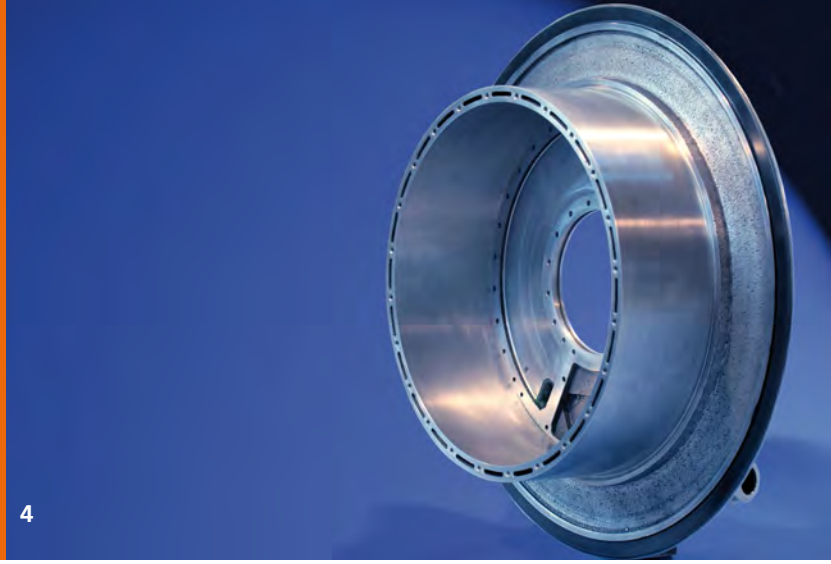

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Casting technologies with lost model patterns and molds

Complex castings with demanding geometric details can be produced in a variety of metal alloys using the **lost foam**, **investment casting and low pressure casting methods**. The lost foam and investment casting processes, in particular, produce extremely complex parts in near-net-shape directly from the mold without burrs or the need for labor-intensive de-coring. All three methods are suitable for the fast production of one-off parts, prototypes and functional specimens, and can also be easily implemented in industrial series production.

The **lost foam** method offers outstanding possibilities for the production of medium to large castings that at the same time have complex geometries as a result of undercuts and integrated hollows or ducts. This complexity is achieved by joining polymer foam segments to create a uniform model. During the casting process, the thermal energy of the melt decomposes the model material and fills the resulting voids in the mold producing a cast which is true to detail. As a result the melt forms an exact geometric image of the model.

Investment casting is particularly suitable for the production of small parts with complex geometries and outstanding surface finishes. Wax model patterns – the basis for the lost ceramic molds – are produced by injection molding or rapid prototyping. In the furnace the wax is melted out and the mold preheated ready for casting. Casting is performed with differential pressure and under inert gas so that not only standard melts but also special alloys and pure metals can be processed. Fraunhofer IFAM uses the investment casting method to produce parts with close dimensional tolerances, very good surface finishes and pronounced details.

The flexibly configurable **low pressure casting** plant at the institute allows a wide array of different melts such as aluminum, magnesium, cast iron, steel and copper to be cast into different mold materials such as steel, sand and ceramic molds. The combination of different mound materials – predominantly sand or ceramics – in conjunction with a wide variety of materials that can be used in lost cores allows complex castings with high quality demands and dense microstructure to be produced by low pressure casting.

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3 *Lost foam pattern for casting of a stator housing for a wheel hub motor.*

4 *Cast housing with integrated water jacket and cooling ducts for an electric motor.*

1

MARKING OF CASTINGS AND SENSOR INTEGRATION

CAST TRONICS®

The *CAST*TRONICS® technology allows direct integration of electronic and adaptronic functional elements into castings during the die casting process. This offers a wider range of electronic, sensor or actuator functions by comparison with conventional castings.

RFID marking for metal castings

Until now the **marking of metallic castings** has been limited to conventional methods such as barcode or data matrix code (DMC). At Fraunhofer IFAM, RFID transponders are integrated into castings enabling an electronic, radio-based marking and identification of cast products. The RFID transponder can be applied later to existing castings, but also integrated into the casting directly during casting using the patented *CAST*TRONICS® process.

The established **RFID technology** stands for an electronic, contact-free and smart identification of products and components (RFID = Radio Frequency ID) and is regarded as a logical further development of marking methods used to date. The RFID transponder has a globally unique serial number and can also be expanded to include customized codes in order to ensure unambiguous marking. RFID functions by radio, requires no visual contact, is reliable and practically invisible - and thus offers benefits for industrial applications:

- Electronic encoding without optical marking features
- Simultaneous identification of several castings possible
- Resistant to rugged industrial environments and soiling or damage to the surface of the casting
- Higher security of the data integrity and scanning quota
- Encryption of the information is possible
- Counterfeit protection for castings
- VDA-conformant encoding

The casting is already unambiguously marked on removal from the mold and can no longer be confused. Counterfeiting is also no longer possible. Damage, loss or manipulation – with the *CAST*TRONICS® technology the encoding of the casting is protected. By contrast with visual marking methods, parts with integrated transponder are still clearly identifiable even after surface treatment, e.g. due to coating, blasting or soiling.

The transponder cast into the casting offers not only the pure identification but also a **counterfeit protection** function as an electronic seal of authenticity against product piracy and confusion. The integrated chip can no longer be removed without visible damage to the casting, and replacement is not possible.

Fraunhofer IFAM supports the foundry industry with the pro-active, early entry into the RFID technology. If a few centimeters of scanning range are sufficient, the robust system frequency 125 kHz (LF) predominant in the metal industry to date is used. The next technological step is now being taken with the use of the 868 MHz (UHF) frequency to increase the scanning range for castings with integrated RFID transponder to up to one meter.

2

3

Structural health monitoring with integrated sensors

Sensors cast into the part allow mechanical loads in the part such as compressive and tensile forces, deformations or vibrations to be detected, measured and assessed. Due to the integration during the casting process, the sensors can be embedded into the part directly at the point where the loads occur in order to warn of overloading or damage to the part. This enables **structural health monitoring**, a crucial benefit particularly for safety components. Furthermore, the vibration behavior of components and their acoustics can be actively influenced by integrated piezo actuators ("structural health control").

Conventional sensors for monitoring the load state of components and their deformation – for example, strain gauges – have to be applied to the surface of a part. Integrated sensors cast into the part offer the benefit that after the casting process, they are protected against soiling, damage or loss – both for further mechanical machining processes on the casting, during assembly and during operation. In addition, the integration during casting allows an **optimum bond** to be created between the sensor elements and the material structure. Additional machining and joining processes for application of the sensors can be eliminated.

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1 *Casting with integrated UHF-RFID transponder for large scanning distances.*
2 *Die casting with cast-in integrated RFID transponder and hand-held scanner.*
3 *Belt conveyor with UHF RFID scanning system for identification of castings in a fully automated production and assembly line.*

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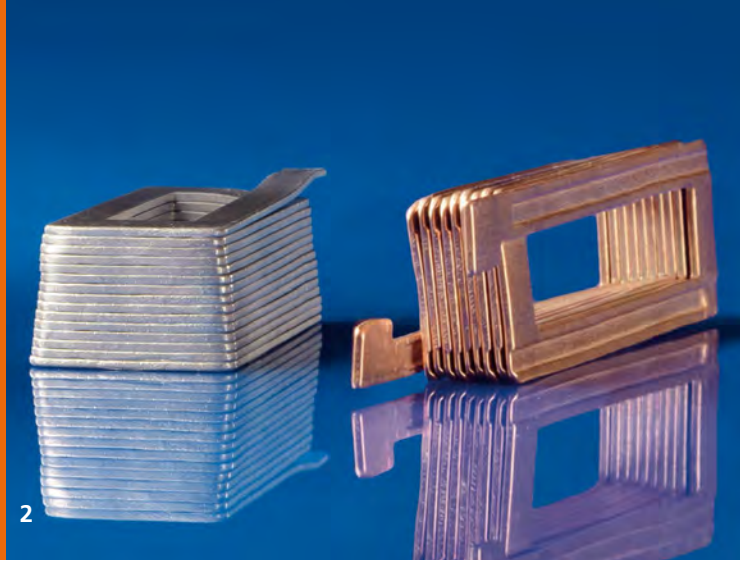

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COMPONENTS FOR ELECTRIC MACHINES

MOBILITY THROUGH CASTING

Electromobility is a topic that is gaining in importance, not least in the area of casting technology, leading to increasing demand for the development of new cast components. The focus is on castings for electric drives and motor vehicles. The close interdisciplinary cooperation between the "Electric Drives" department and our other departments creates an optimum know-how constellation, allowing the holistic consideration of production engineering aspects with a primary focus on casting, engineering planning and electromagnetic design for the successful production of components for electric machines.

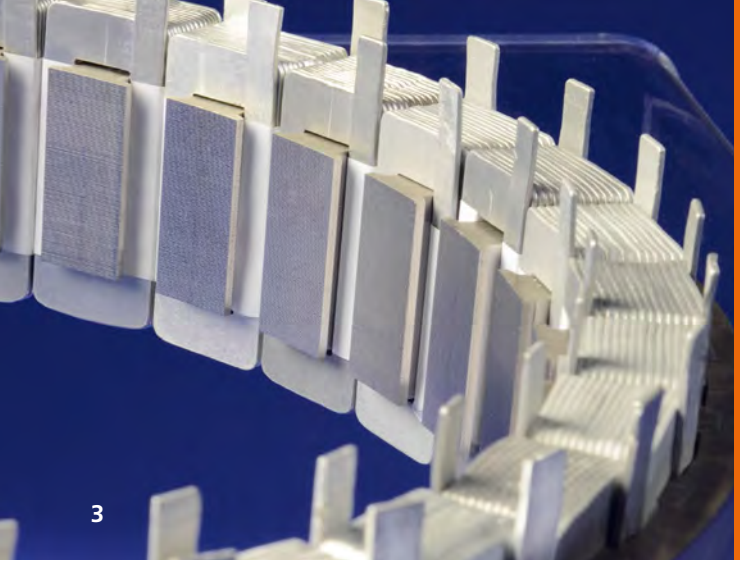
Cast coils

Cast coils offer excellent potential for boosting the performance of electric machines. An integrative production method developed at Fraunhofer IFAM is employed for the manufacture of these innovative components. Fields of application are to be found in particular in electric motors for cars and commercial vehicles, for industrial drives and in high-efficiency generators.

This method allows us to produce the coil geometries with a flat conductor arrangement, which offer significant advantages compared with conventionally produced wound coils. Production by casting allows a specific and individual adaptation of the conductor cross-section, allowing maximum use to be made of the installation space available in electric motors. This allows slot-filling factors of over 80 percent to be achieved, while at the same time reducing electrical resistance by up to 50 percent. New cooling concepts made possible by flat construction also enable a further increase in the current density. The feasibility and technological benefits of cast coils have already been demonstrated in various applications.

Depending on the size and number of coils to be produced, different casting methods can be employed. In investment casting, low conductor heights (> 0.7 mm) can be achieved with coil lengths of up to 200 mm, while coils produced using the lost foam method can have edge lengths of up to 1 meter. For large quantities, production of the coils in permanent molds results in the lowest unit costs. A complete investment casting process chain is available for the production of prototypes and small pre-production series made of aluminum and copper.

Through intensive cooperation with our departments from the fields of surface technology, in particular "Adhesion and Interface Research" and "Paint/Lacquer Technology", customized insulation coatings can be developed, implemented and optimized. In this way we can satisfy the electrical and thermal specifications of our clients with respect to insulation strength, minimizing the coating thickness and increasing the heat resistance and aging resistance, with a minimum of development time.



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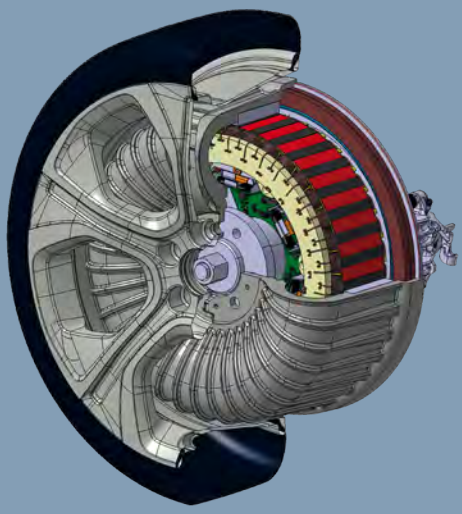

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Castings for electric machines

Particular importance is attached to the development of cast components for electric drives. The requirements for a later transfer to series production are taken into account at all times. The main focus is on actively or passively cooled housings and on metal melt-infiltrated rotors and laminated stacks. The most suitable casting method for the application is chosen and where necessary, additional technologies such as lost cores are employed. The lost foam method is used for production of the housing components as it allows highly complex constructions to be created and internal cooling ducts for coils or power electronics can also be directly integrated into the casting.

Apart from casting production, pilot applications and tests of electric motors are also available at Fraunhofer IFAM. Complete electric motors can be designed at the institute and checked on test stands and in operation in various demonstrator vehicles under dynamic driving conditions.

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1 *Fraunhofer wheel hub motor for demonstration of cast components on the Frecc0 electric vehicle.*
2 *Cast coils of aluminum or copper produced by investment casting.*
3 *Stator of a wheel hub motor with cast aluminum coils arranged in a ring.*
4 *Schematic drawing of a wheel hub motor with cast stator and rotor for series production.*

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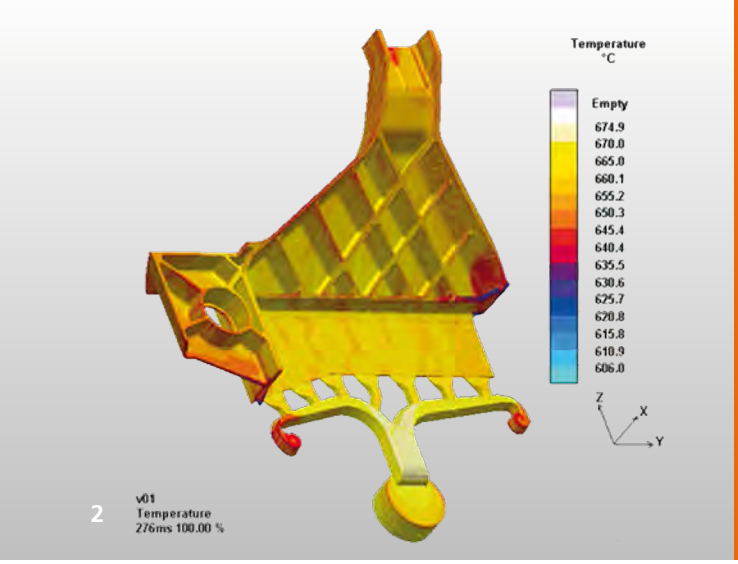

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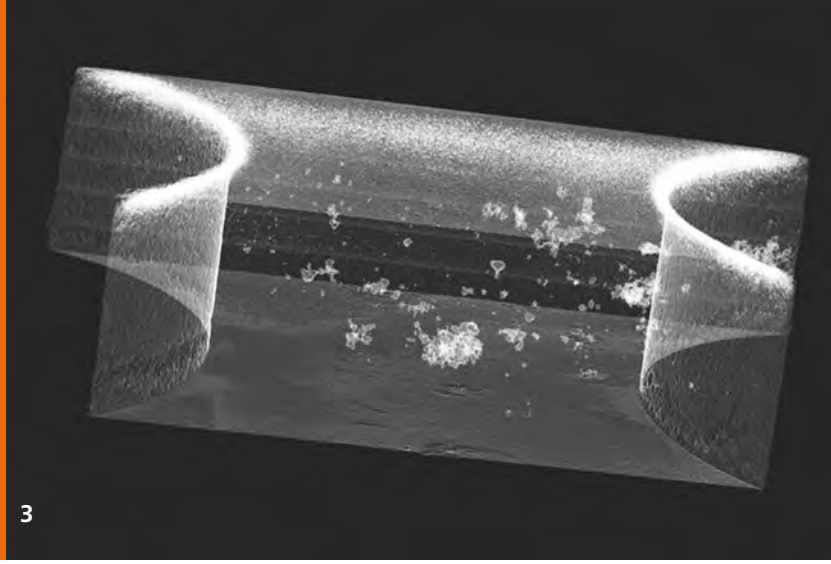

3

NUMERICAL SIMULATION

LOOKING AHEAD

Mold filling and solidification simulation

The simulation of mold filling and solidification is an useful instrument for the design of casting molds which is both cost-effective and time-efficient. Fraunhofer IFAM uses the industrial standard software programs for casting simulation. The goal of the simulation, apart from the mold design, is to optimize the process parameters and to determine the final product properties (e.g. localized discontinuity distribution).

Integrated computational materials engineering (ICME)

Casting simulation is considered in ICME as a link in the chain of the whole product lifecycle. It allows, for example, the influence of casting pores on the crash behavior of motor vehicle parts to be investigated. Stochastic material models are developed which allow statistical distributions of the local material properties (e.g. elongation at break) to be described. These models can be used in the conventional structural analysis programs (FEM) which are also available at Fraunhofer IFAM.

Lightweight construction through robust design

Lightweight construction faces the challenge of producing technical components with a high rigidity and low weight. Apart from lightweight designs and materials, new methods of hybrid lightweight construction (e.g. aluminum-CFRP structures) are now opening up new possibilities for further optimization. At the institute, a method has been developed for this, based on biological bone remodeling processes that distribute different material phases in the part in such a way that maximum rigidity is achieved. This allows us to take statistical variations and uncertainties into account when drawing up design guides for the use of cast structures in hybrid parts (robust design).

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1 *Cast aluminum car body node.*
2 *Mold filling and solidification simulation.*
3 *Micro-CT porosity (© Fraunhofer IIS/EZRT).*

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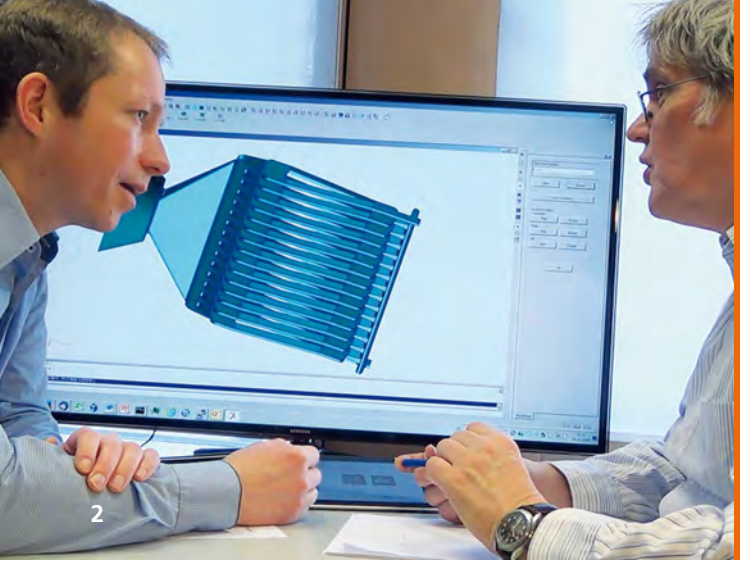

TECHNOLOGY CONSULTING

RESEARCH AND DEVELOPMENT FROM A SINGLE SOURCE

Consultancy and Feasibility Studies

With range of competencies and expertise of the staff at Fraunhofer IFAM, we are able to put together interdisciplinary project teams to provide the client with the advice required. We advise our clients on every aspect from the right design and dimensioning of the part for casting through the evaluation and choice of suitable casting methods and materials through to the testing of pre-series production processes.

Fault and Process Analyses

Faulty castings or problems in processes can have a vast array of causes with often complex interrelationships. Our experts have many years of experience with different casting methods and materials, their idiosyncrasies and the resulting demands. We collaborate with the customer to evaluate and analyze problems, investigate the causes and then develop appropriate solutions and measures.

Workshops and Personnel Qualification

The application of new technologies and materials in creating new products and their transfer to existing processes in series production can only be successful if the personnel are also correspondingly qualified. The personnel qualification provides an important technology transfer during which the latest scientific findings and methods become established in industrial practice and younger staff become qualified.

Seminars on our research topics and casting principles are equally as possible as customized workshops customized individually to your wishes of the needs of the project. The know-how conveyed can be further deepened by practical demonstrations in the casting pilot plant, the application of new materials and technologies can be tested and the efficient use of the different casting methods trained.

→ **www.ifam.fraunhofer.de/casting**

1 *The casting technology building at Fraunhofer IFAM.*
2 *Workshop on casting design.*
3 *Consultancy meeting as part of a fault and process analysis.*

OUR OFFER

HAVE YOU GOT AN IDEA AND ARE LOOKING FOR THE RIGHT PARTNER FOR IMPLEMENTING IT?

We offer our clients and project partners a broad range of services customized individually to their needs, from consultancy through project planning up to the implementation of the project. We can support you in your development projects, and also in the transfer of project results to existing processes.

With our interdisciplinary team of experienced scientists and technologists, we can provide answers for all your questions. We will work together to find innovative solutions and develop concepts for the implementation of your idea, from the start of the process right up to the completion of the finished product. It goes without saying that you can count on us for complete confidentiality.

Through collaborations with other competence centers at Fraunhofer IFAM during the project, we can provide answers to any further questions you might have. Examples of successful projects we have undertaken include development and of, amongst others, the localized plasma coating of castings for corrosion protection, the bonding of coatings using pre-applicable adhesives, and electrical insulation protection coatings for cast coils for use in automotive electric motors.

Casting Technology at Fraunhofer IFAM offers you research and development from a single source.

Technology consultancy in the processes

- High pressure die casting
- Low pressure casting
- Lost foam casting
- Investment casting
- Sand casting

Experimental research & development

- Feasibility studies and market analyses
- Process and technology development
- Material development for foundry materials
- Casting of prototypes and functional specimens right up to the pre-production series
- Fault and process analysis
- Numerical simulation

Quality testing and analysis

- X-ray testing and CT
- Alloy analysis
- Electrical conductivity of alloys
- Materialography and material testing
- Measurement technology for recording thermophysical data (temperature, thermal conductivity, heat of decomposition, etc.)

Consulting and know-how transfer

- Scientific project support and consultancy
- Workshops
- Personnel training

LOCATIONS

Institute Directors
Prof. Dr.-Ing. habil. Matthias Busse
Prof. Dr. Bernd Mayer

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LOCATIONS AND DEPARTMENTS

BREMEN
- Adhesion and Interface Research
- Company audits in accordance with DIN 6701 | Adhesive Bonding Technology
- Business Development
- Chemistry of Fiber Reinforced Plastics
- Electrical Drive Systems
- Energy System Analysis
- Functional Printing
- Casting Technology
- Adhesives and Polymer Chemistry
- Adhesive Bonding Technology
- Paint/Lacquer Technology
- Materialography and Analysis
- Plasma Technology and Surfaces
- Powder Technology
- Technical Qualification and Consultancy
- Workforce Training and Technology Transfer
- Materials Science and Mechanical Engineering

DRESDEN
- Energy and Thermal Management
- Sintered and Composite Materials
- Cellular Metallic Materials
- Hydrogen Technology

OLDENBURG
- Electrical Energy Storage Systems

STADE
- Automation and Production Technology

WOLFSBURG
- Lightweight Design and Electromobility

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