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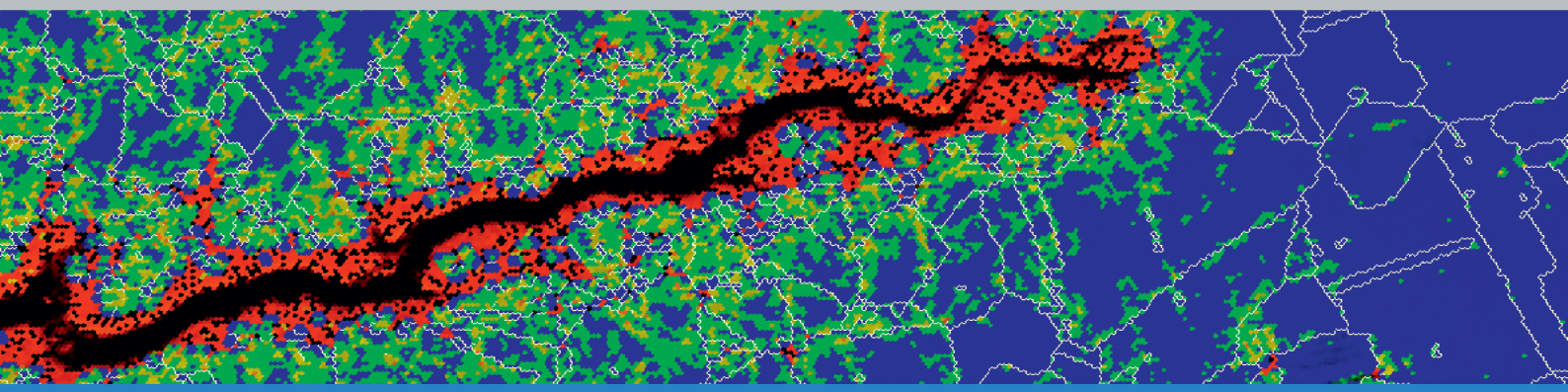
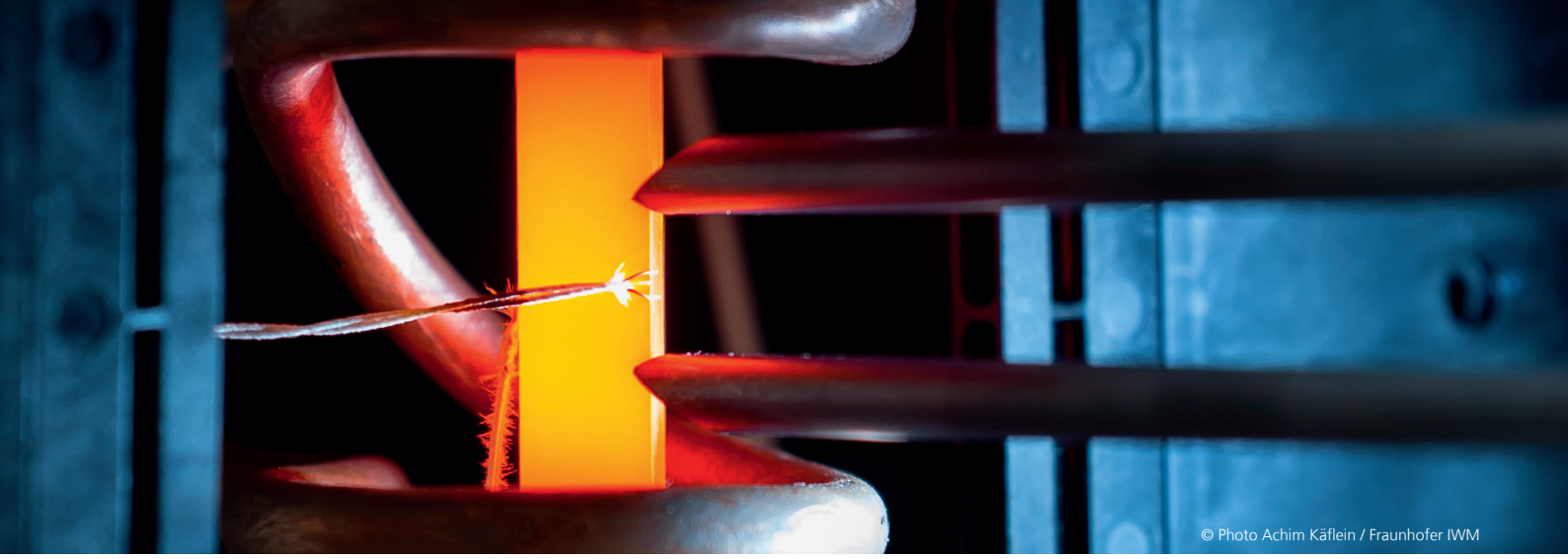
FRAUNHOFER INSTITUTE FOR MECHANICS OF MATERIALS IWM



OPTIMIZED USE OF MATERIAL PROPERTIES – NEW MATERIAL AND COMPONENT FUNCTIONS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Fraunhofer IWM Business Units

We carry out specific tasks for our clients in our business units. In order to gain the greatest benefit from the scientific and technological expertise of our scientists and engineers, Fraunhofer IWM research and development activities are bundled thematically, enabling us to provide the best solutions to our clients on a project by project basis. The competence-based set-up of our business units positions us to supply materials related solutions along the entire product life cycle.

Business Unit Materials Design

We explain material behavior and predict material properties using computational and experimental methods based on solid-state physics and materials mechanics. Our ambition is the targeted design of structures, properties, and functions. We identify the effects of crystalline defects and microstructures on the macroscopic behavior of materials. This enables us to make effective and efficient use of material and energy resources in order to achieve sustainable improvements to technical systems.

Services

- Multiscale, experimental and computational design of materials for multifunctional tasks
- Identification of material properties, development of material models, predication of physical, chemical and mechanical properties, material substitution, material screening
- Materials modeling using methods based on quantum mechanics (from first principles, density function theory) on classical atomistic mechanics (molecular dynamics), and on multiscale materials modeling (MMM)
- Development and production of functional thin-film and multilayer systems, nanometer- and micrometer-scale material structures
- Determination of micromechanical local properties and lifetime assessment
- Combinational high-throughput screening, experimental and computational, to identify novel material systems with specific structures and compositions for desired properties and functions
- Design and manufacture of artificial mesoscale meta-materials with novel properties

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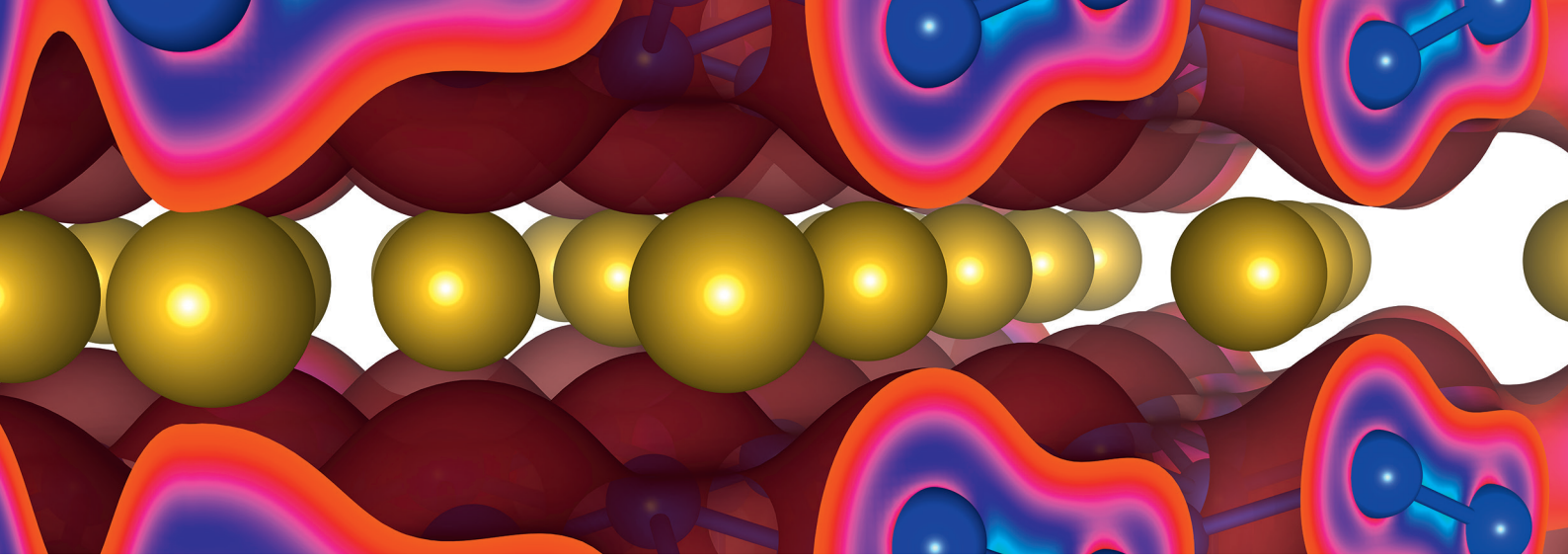

Business Unit Manufacturing Processes

Our understanding of processes and sophisticated simulation techniques enables us to design efficient and reliable manufacturing processes. Our services include investigations into and the technological development of manufacturing processes for the production of semi-finished products and components with functional properties. This work ranges from powder technology processes, including complex fluid systems, to microfluids, the forming and processing of ductile materials as well as processing techniques for brittle materials and glass forming.

Services

- Innovative manufacturing processes for precision contours and functional components with defined property profiles
- Simulation-assisted optimization of the energy and material efficiency of manufacturing processes
- Modeling and simulation of powder technology and fluid dynamic processing stages, simulation methods for generative manufacturing
- Forming process simulations including microstructure development and thermodynamics
- Forming, processing and damage analyses for brittle materials such as glass and silicon
- Investigation and optimization of abrasive and erosive processes

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Business Unit Tribology

This business unit carries out research on friction and wear. We optimize tribological systems and develop solutions that reduce friction and protect against wear with the aid of technical ceramics, innovative lubricants, tribological coating systems and tribo-materials conditioned through manufacturing technology. We investigate friction, abrasion, running-in and wear mechanisms as they affect the tribo-chemistry of machine elements such as roller and slide bearings, cutting and forming tools or motor and gearbox elements. We use experimental techniques, multiscale modeling and numerical simulations as well as microstructure analysis.

Services

- Determination of mechanical and tribological properties of materials, composites and coatings under operational conditions
- Evaluation and optimization of the performance of protective wear-resistant coatings and friction contacts
- Load analyses, trials and evaluation of failure mechanisms for metal, ceramic and polymers components
- Production and evaluation of smooth and structured diamond-like carbon coatings for extreme tribological conditions
- Development and application of lifetime prediction methods

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Business Unit Component Safety and Lightweight Construction

The assessment of lightweight structures and components with safety-relevant demands under operational loads represents the center of our research work. The applications range from proving the safety of power plant components to confirming the defect tolerances of civil, vehicle and aerospace components to crash analyses of vehicle components. The focus is on the operational behavior of modern metallic materials as well as joins, composites and multi material constructions.

Services

- Characterization and modeling of materials and components taking into account service relevant loading from creep to fatigue to impact and crash
- Assessment concepts to prove the structural integrity of highly stressed safety-relevant components
- Fracture mechanics safety analyses, assessment of defect tolerance and derivation of inspection intervals
- Crash simulations of automotive and railway components with customized material models
- Assessment of weldments and adhesive and mechanical joins with respect to service and crash loads
- Process simulation: mechanical joining, welding and mechanical surface treatments for durability enhancement
- Experimental and numerical assessment of composites and multi material constructions
- Probabilistic analyses

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Business Unit Assessment of Materials, Lifetime Concepts

We assess the influence of microstructure, internal stresses and damage on component functionality and life expectancy. We are particularly interested in linking specific analyses and experiments to advanced material models and in understanding the demands placed on our clients' components. Our work is focused on modeling cyclical thermomechanical loads and on identifying the degradation mechanisms involved in corrosion, stress corrosion cracking and hydrogen embrittlement. In acute cases of damage, we can carry out surveys for our clients.

Services

- Simulation, identification and assessment of the microstructure and internal stresses related to manufacturing and loading
- Investigations into material degradation through corrosion, stress corrosion cracking and hydrogen embrittlement
- Identification of damage mechanisms associated with cyclical thermomechanical loads
- Mechanism-based material models for time and temperature related plasticity and damage
- Software for calculating life expectancy using finite elements programs
- Damage analysis, identification of technical liability, surveys, development of new testing techniques
- Construction of test rigs

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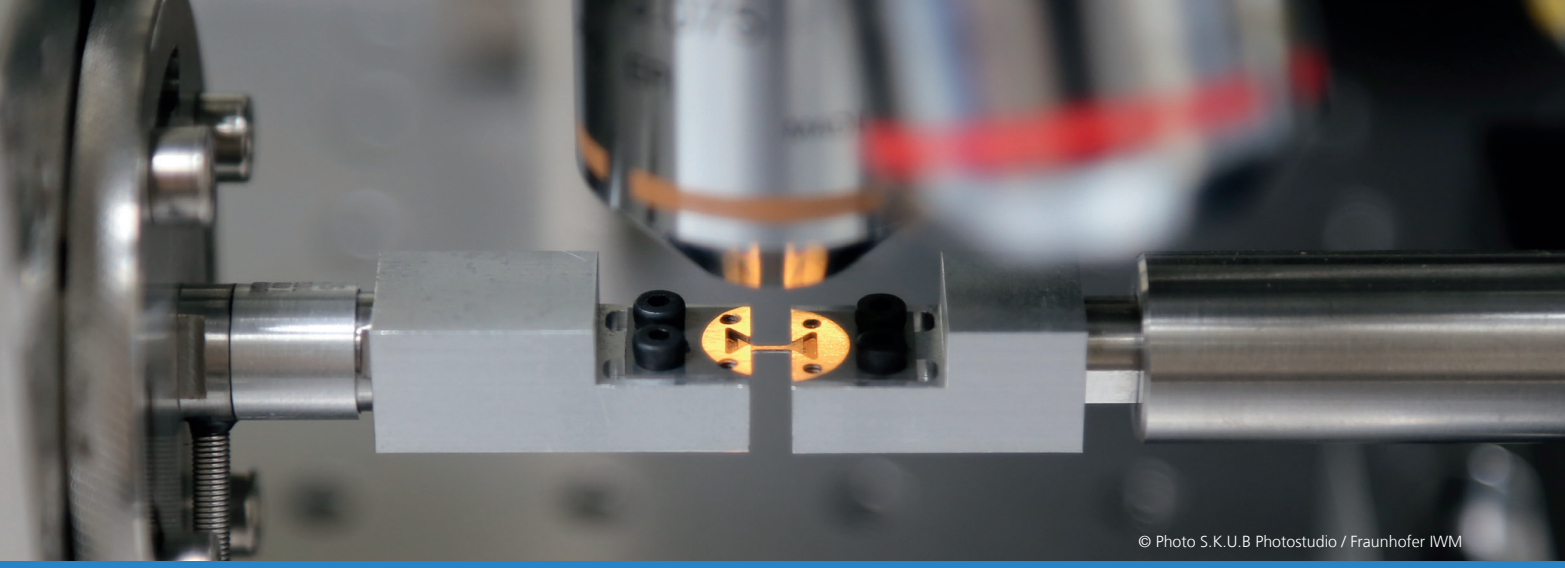

Solutions for the Optimized use of Material Properties and for New Material Functionalities

Our Services:

Characterization and Analysis

- We determine material and component properties under mechanical, thermal, tribological and corrosive loads
- We analyze the structure of materials from the macroscopic to the atomistic scales
- The methods we develop enable us to test materials and components under precisely replicated complex stresses

Description, Evaluation, Simulation

- We clarify material changes, both during the manufacturing process and in use and predict impacts regarding reliability, safety and the life expectancy of components
- We develop material models to describe material mechanisms such as crack formation, deformation, failure, wear and fatigue
- We simulate material and component behavior on various scales during the production process as well as when in use

Development and Optimization

- We develop solutions along the entire process chain to achieve higher manufacturing yield and energy efficiency, increased component life expectancy and improved component quality
- We develop resource efficient manufacturing steps
- We develop functional coatings and sustainably functional materials

Cooperation with the Fraunhofer IWM starts with a non-binding consultation. Together we gauge which goals are reachable and identify both time and financial constraints. Our professional approach to your project is unrelated to the size of the project and your information is treated with strict and utmost confidentiality. A confidentiality and non-disclosure agreement can be included in the cooperation contract at the request of the client.

We investigate the operational behavior of materials from a practical and customer-oriented point of view and develop new components and processes. The latest findings in the fields of materials science and materials technology provide the basis for new insights and often quite remarkable models that describe the performance limits of components and systems. Allow us to convince you of our competencies and together we can find a customized solution for your issues.

Please get in touch!

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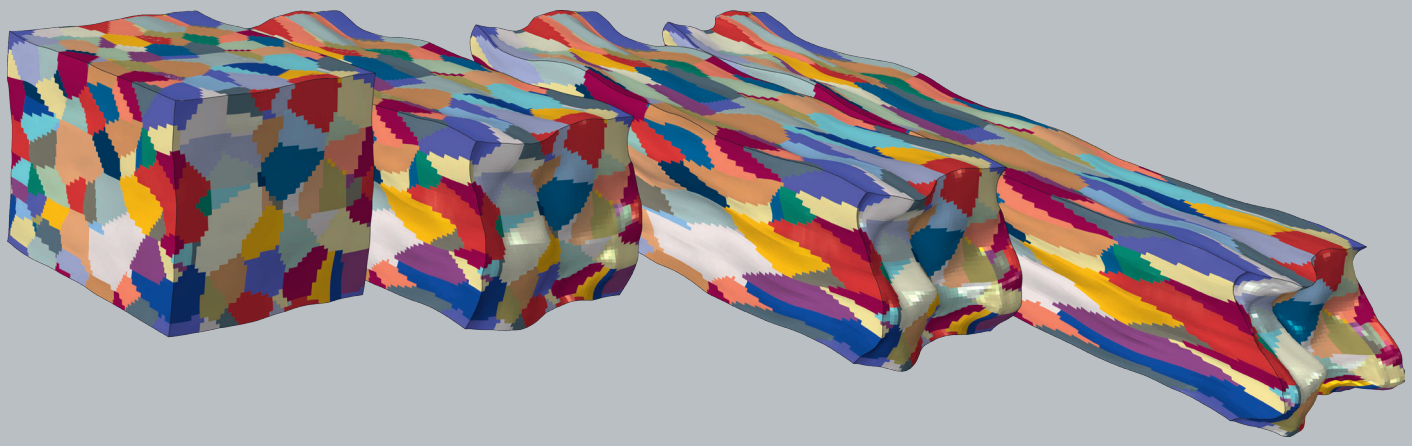

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Application Oriented Contract Research: Mechanics of Materials Expertise for Your Competitive Advantage

Whether you are in business or a public institution, we address your materials related research and development concerns in application-oriented projects from damage analysis and process development to materials innovations.

We realize solutions for the optimized use of material properties to improve the reliability, life expectancy and safety of components and develop new materials as well as resource-efficient manufacturing processes.

Our research focuses upon material changes in processes and components. For this purpose, we are developing specific material models, characterization and simulation methodologies.

Fraunhofer: Research for the Future

The Fraunhofer-Gesellschaft is the largest organization for applied research in Europe. Our fields of research are determined by the needs of society: health, safety, communication, mobility, energy and the environment. As a result, the work of our researchers and developers has a large influence on the future of people's lives. We are creative, we shape technology, we design products, we improve processes, we open new paths. We invent the future.

- Fraunhofer's research activities are conducted by 67 institutes and research units at locations throughout Germany
- The Fraunhofer-Gesellschaft employs a staff of 24,000, predominantly consisting of qualified scientists and engineers
- The Fraunhofer-Gesellschaft works with an annual research budget totaling more than 2.1 billion euros. Of this sum, more than 1.8 billion euros is generated through contract research
- More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects with approximately 30 percent coming from the federal and state governments as basic funding
- International collaborations with excellent research partners and branches around the world

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