JAHRESBERICHT
ANNUAL REPORT

25

INM Leibniz-Institut für Neue Materialien

Leibniz Gemeinschaft

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Prof. Dr. Wilfried Weber
Wissenschaftlicher Geschäftsführer / Scientific Director

Prof. Dr. Aránzazu del Campo
Wissenschaftliche Geschäftsführerin und Vorsitzende der Geschäftsführung / Scientific Director and CEO

Michael Marx
Kaufmännischer Geschäftsführer / Business Director

LIEBE LESERINNEN UND LESER, WILLKOMMEN ZUM JAHRESBERICHT 2025 DES INM!

Im letzten Jahresbericht hatten wir ausführlich über die Vorbereitungen und die Evaluierung des INM im Juni 2024 berichtetet. Am 21. Mai 2025 beschloss nun der Ausschuss der Gemeinsamen Wissenschaftskonferenz von Bund und Ländern (GWK) die Weiterförderung des INM. Damit ist die Finanzierung des Instituts für den Zeitraum von 2025 bis 2031 gesichert.

Die wissenschaftlichen Highlights zeigen einmal mehr die Vielfalt und Innovationskraft der Forschung am INM. Exemplarisch zu nennen sind das Recycling metallischer Komponenten in gedruckter Elektronik, die Integration künstlicher Zellen in 3D-Tumorkulturen, die Entwicklung energiesparender

DEAR READERS, WELCOME TO THE ANNUAL REPORT OF THE INM!

In our last annual report, we provided a detailed account of the preparations for and the evaluation of the INM in June 2024. On May 21, 2025, the Committee of the Joint Science Conference of the Federal Government and the States (GWK) decided to continue funding the INM. This secures the institute's funding for the period from 2025 to 2031.

The scientific highlights once again demonstrate the diversity and innovative strength of research at the INM. Examples include the recycling of metallic components in printed electronics, the integration of artificial cells into 3D tumor cultures, the development of energy-saving coating processes for the manufacture

Beschichtungsverfahren für die Herstellung optischer Elemente oder die gezielte Entwicklung von Oberflächen im Hinblick auf ihre taktile Wahrnehmung.

Auch im Bereich Personalia gab es wichtige Entwicklungen. Besonders hervorzuheben ist die Wiederbesetzung der Leitung der Forschungsabteilung *Innovative Elektronenmikroskopie* durch Prof. Dr. Nadezda Tarakina: Gefördert durch das Professorinnenprogramm der Leibniz-Gemeinschaft nahm sie im September 2025 ihre Tätigkeit am Institut auf. Zeitgleich trat sie ihre Professur für Innovative Elektronenmikroskopie an der Universität des Saarlandes an. Im Berichtsjahr wurden zudem zwei neue INM-Fellows ernannt. Seit 1. Januar 2025 ist Prof. Dr. Julia Schulze-Hentrich, Professorin für Genetik an der Universität des Saarlandes, INM-Fellow. In Kooperation mit dem INM untersucht sie die Interaktion von Zellen mit (therapeutischen) Materialien auf genetischer und epigenetischer Ebene. Weiterhin wurde Prof. Dr. Matthias Finkbeiner, Professor an der TU Berlin, am 1. Mai 2025 INM-Fellow. Als Experte für Sustainable Engineering und Technischem Umweltschutz trägt er maßgeblich zur Weiterentwicklung von Methoden zur ganzheitlichen Umweltbewertung (Life Cycle Assessment) und von neuen therapeutischen Materialien im Rahmen des Leibniz-WissenschaftsCampus *Lebende Therapeutische Materialien* bei. Die INM-Fellowship stellt ein wichtiges Instrument zur Stärkung der wissenschaftlichen Vernetzung dar.

Der Technologietransfer nahm Fahrt auf: Erstmalig wurden 2025 zwei Technologietransfer-Tage veranstaltet, einmal zum Thema Smart Contact Lenses, zum andern zum Thema Living Therapeutic Materials. Darüber hinaus stand das Jahr in besonderem Maße im Zeichen des Wissenstransfers: Auf der interaktiven Ausstellung an Bord des Schiffes „MS Wissenschaft“, die sich dem Thema Zukunftsenergien widmete, präsentierte die Forschungsabteilung Energie-Materialien ihre Arbeiten zur elektrochemischen Lithiumgewinnung aus wässrigen Lösungen, etwa aus Grubenwasser. Das schwimmende, vom BMFTR geförderte, Science Center machte in 30 Städten in Deutschland und Österreich Halt. Zudem beteiligte sich das INM an den Feierlichkeiten zum Tag der Deutschen Einheit im Saarland. Im Rahmen des Bürgerfests präsentierten fünf Forschungseinheiten auf der Wissenschaftsmeile ihre aktuellen Arbeiten einer breiten Öffentlichkeit.

Diese und weitere Einblicke in Neues und Spannendes aus dem INM bieten Ihnen die nachfolgenden Seiten. Wir wünschen Ihnen eine anregende Lektüre.

of optical elements, and the targeted development of surfaces with regard to their tactile perception.

There were also significant developments in personnel matters. Of particular note is the appointment of Prof. Dr. Nadezda Tarakina as head of the *Innovative Electron Microscopy* Research Department: supported by the Leibniz Association's Women Professors Program, she began her work at the institute in September 2025. At the same time, she assumed her professorship in Innovative Electron Microscopy at Saarland University. Two new INM Fellows were also appointed during the reporting year. Since January 1, 2025, Prof. Dr. Julia Schulze-Hentrich, Professor of Genetics at Saarland University, has been an INM Fellow. In cooperation with the INM, she investigates the interaction of cells with (therapeutic) materials at the genetic and epigenetic levels. Furthermore, Prof. Dr. Matthias Finkbeiner, a professor at TU Berlin, became an INM Fellow on May 1, 2025. As an expert in sustainable engineering and technical environmental protection, he plays a key role in advancing methods for holistic environmental assessment (Life Cycle Assessment) and developing new therapeutic materials as part of the Leibniz Science Campus *Living Therapeutic Materials*. The INM Fellowship represents an important tool for strengthening scientific networking.

Technology transfer gained momentum: In 2025, two technology transfer days were held for the first time, one focusing on smart contact lenses and the other on living therapeutic materials. Furthermore, the year was particularly marked by knowledge transfer: At the interactive exhibition aboard the ship “MS Wissenschaft,” which was dedicated to the topic of future energies, the Energy Materials research department presented its work on the electrochemical extraction of lithium from aqueous solutions, such as mine water. The floating science center, funded by BMFTR, made stops in 30 cities across Germany and Austria. In addition, the INM participated in the celebrations for German Unity Day in Saarland. As part of the public festival, five research units presented their current work to a broad audience on the Science Mile.

The following pages offer you further insights into new and exciting developments at the INM. We wish you a stimulating read.

Das wissenschaftliche Profil des INM / Scientific profile of INM

INM VISION

Gemeinsam verfolgen wir die Vision, durch die Entdeckung und Entwicklung neuer Materialien zu einer besseren Welt beizutragen.

We are driven by our joint vision to contribute to a better world by discovering and engineering new materials.

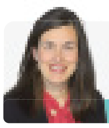
INM MISSION

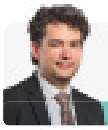
Wir erforschen neue Werkstoffe aus chemischen und lebenden Komponenten, die in Bezug auf Funktionalität, Leistungsfähigkeit und Nachhaltigkeit Grenzen überschreiten.
Wir entwickeln unsere Materialien, um nachhaltige Technologien voranzutreiben und gesellschaftliche und technologische Herausforderungen in Synergie mit akademischen und industriellen Partnern zu lösen.

We explore new materials from chemical and living components that overcome frontiers in functionality, performance, and sustainability. We design our materials to drive sustainable technologies and solve societal and technological challenges in synergy with academic and industrial partners.

WISSENSCHAFTLICHE EINHEITEN DES INM / SCIENTIFIC UNITS OF INM

RESEARCH DEPARTMENTS


Dynamic Biomaterials
Aránzazu del Campo


Energy Materials
Volker Presser


Innovative Electron Microscopy
Nadezda Tarakina


Interactive Surfaces
Roland Bennewitz


Materials Synthetic Biology
Wilfried Weber


Optical Materials
Peter William de Oliveira

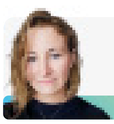

Structure Formation
Tobias Kraus

RESEARCH GROUPS


Bioprogrammable Materials
Shrikrishnan Sankaran


Electrofluids
Lola González-García


Immuno Materials
Oskar Staufer


Materials-Host Interactions
Sara Trujillo-Munoz

TRANSFER


Innovation Center INM
Carsten Becker-Willinger


Innovation Center INM
Peter William de Oliveira

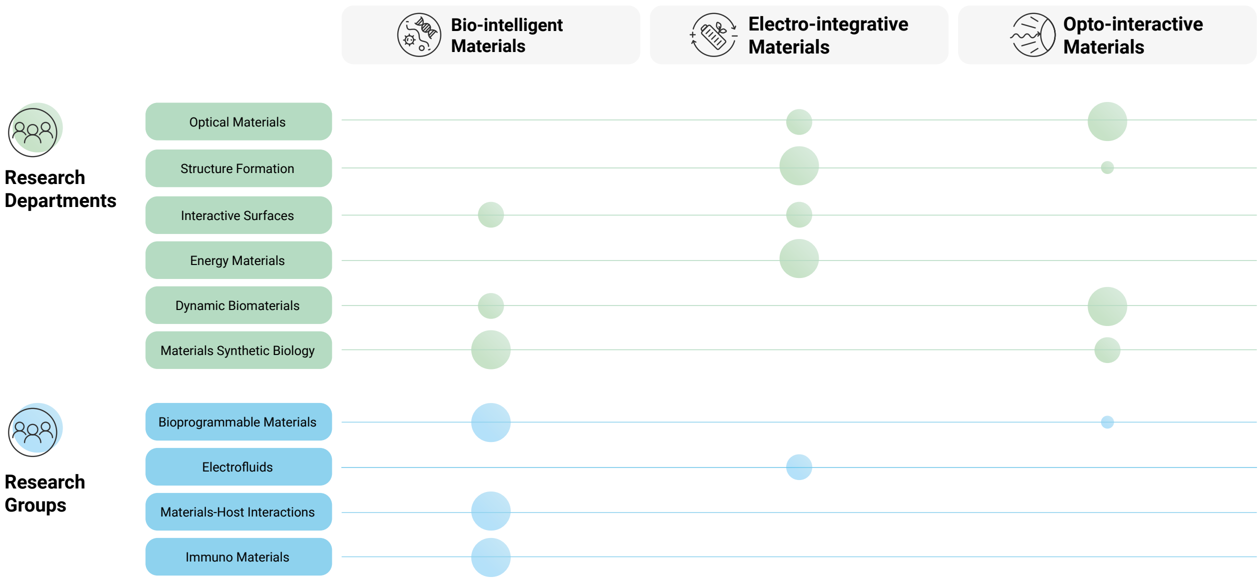
KOMPETENZFELDER / COMPETENCE AREAS OF INM

Das INM hat drei Kompetenzbereiche identifiziert, in denen es strategische Führung anstrebt:

- **Opto-interaktive Materialien:** Wir entwickeln Materialien, die das Verhalten von Licht modulieren oder die durch die Interaktion mit Licht moduliert werden.
- **Elektro-integrative Materialien:** Wir entwickeln Materialien, die ein hochdichtes Ionenmanagement oder eine auf Reize reagierende Leitfähigkeit integrieren.
- **Bio-intelligente Werkstoffe:** Wir entwickeln Materialien, die biologische Systeme instruieren und wir programmieren lebende Organismen, um Materialien neuartige Eigenschaften zu verleihen.

INM has identified three competence areas in which it aims for strategic leadership:

- **Opto-interactive materials:** We develop materials that modulate light behavior, or that are modulated upon interaction with light.
- **Electro-integrative materials:** We develop materials that integrate high-density ion management or stimulus-responsive conductivity.
- **Bio-intelligent materials:** We design materials that instruct biological systems and we program living organisms to confer novel properties and functions to materials.



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Berichte der Wissenschaftlichen Einheiten / Reports of the Scientific Units

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Bioprogrammierbare Materialien / Bioprogrammable Materials

Dr. Shrikrishnan Sankaran

ZUSAMMENFASSUNG
Die Forschungsgruppe *Bioprogrammierbare Materialien* entwickelt Engineered Living Materials, indem sie genetisch programmierte Bakterien nutzt, um Materialsystemen Intelligenz, Responsivität und adaptive Fähigkeiten für biomedizinische und biohybride Anwendungen zu verleihen. Diese Arbeit ist im Rahmen des Leibniz-WissenschaftsCampus *Living Therapeutic Materials* angesiedelt. Wir leisten einen Beitrag zum INM-Kompetenzbereichs Bio-intelligente Materialien. Die Gruppe ist darauf spezialisiert, genetisches Schaltungsdesign mit materialbasierter Einschließung zu koppeln, um kontrollierbare und vorhersagbare Funktionen lebender Materialien zu erreichen. Es gibt zwei Hauptforschungsfelder: (i) die Entwicklung probiotischer Bakterien, in denen eine gezielte Synthese und Abgabe funktioneller Biomoleküle durch äußere Signale moduliert wird und (ii) das Verständnis und die Nutzung von Verhaltensänderungen von Bakterien, die in Polymermatrizen verkapselt sind.

MISSION
The Research Group Bioprogrammable Materials develops engineered living materials by harnessing genetically programmed bacteria to impart material systems with intelligence, responsiveness, and adaptive capabilities for biomedical and biohybrid applications. This work is framed within the Leibniz Science Campus *Living Therapeutic Material*, and contributes to INM's Bio-intelligent materials competence area. The group specializes in coupling genetic circuit design with material confinement to achieve controllable and predictable living material functionalities with two main research areas: (i) developing genetically programmed probiotic bacteria for remotely controlled synthesis and delivery of functional biomolecules, and (ii) understanding and leveraging the behavioral changes of bacteria encapsulated in polymer matrices.

CURRENT WORK
In the past year, the *Bioprogrammable Materials* research group advanced lactobacillus-based engineered living materials (ELMs) for therapeutic use. A key achievement was engineering robust genetic switches in probiotic lactobacilli to enable temporal control of engineered functions (Blanch-Asensio et al., J. Contr. Rel. 2025). Because most prior efforts in lactobacillus switching have produced leaky or weak behavior, this addresses a long-standing bottleneck. Using our novel, patent-pending ultra-strong promoter systems, we built switches responsive to food-derived molecules (coop. Prof. Rahmi Lale, NTNU/Syngens, Norway), enabling remote, biocompatible control of protein production. We also discovered a critical limitation: switch performance deteriorates during rapid growth, likely due to intracellular pH shifts that disrupt regulation. Notably, encapsulating bacteria in alginate hydrogel beads—strongly reduced this failure by buffering growth dynamics and the local physicochemical environment. This establishes a practical route to reliable lactobacillus switching for drug-delivery applications.

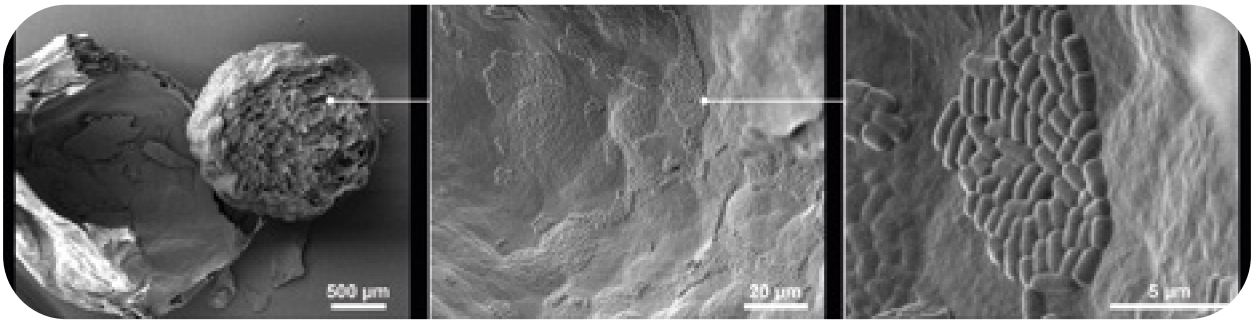
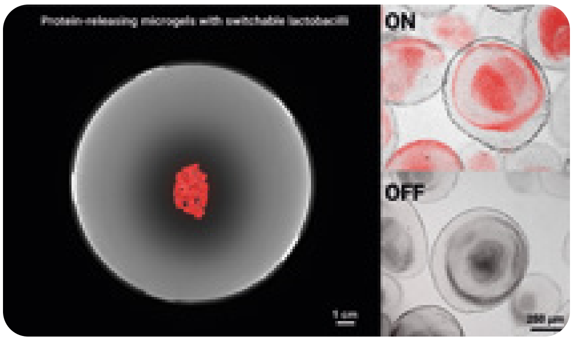


Fig. 1: SEM images of lactobacilli grown as colonies within alginate beads

Fig. 2: Alginate core-shell microgels containing lactobacilli expressing a fluorescent protein and releasing a nuclease that degrades fluorescent DNA to create a dark halo in an agar plate.



The biocompatibility and bioactivity of therapeutic proteins secreted by engineered lactobacilli were proven by the *Materials–Host Interactions* group using an endotoxemia model. Anti-inflammatory proteins produced by our strain modulated inflammatory signaling in macrophages (Deshpande et al., ACS Pharmacol. Transl. Sci. 2025). This validation is now being extended to encapsulated formats, including alginate bead systems, with safety and functional testing underway in zebrafish models (coop. Prof. Rolf Müller, HIPS), providing an important bridge between *in vitro* studies and mammalian experiments.

In parallel, we refined design principles for bacterial behavior under mechanical confinement. With Prof. Karine Glinel (UC Louvain, Belgium), we showed that agarose stiffness determines lactobacillus colony architecture from diffuse to compact aggregates as stiffness increases (Dupont et al., Biomater. Adv. 2025), while initial cell density governs growth and secretion kinetics. Comparing *E. coli* and *L. plantarum* in Pluronic-based hydrogels, the former showed strong stiffness-dependent changes in growth and metabolic adaptation, whereas the latter remained largely unchanged (Tadimarri et al., ACS Biomater. Sci. & Eng. 2025). Mechanical confinement nonetheless enhanced recombinant protein production in both systems, likely via growth restriction, helping define general links between material mechanics, microbial physiology, and ELM performance.

OUTLOOK

Looking ahead, newly funded projects allow us to focus these advances toward clearly defined disease targets. Within the Leibniz Science Campus LifeMat, current projects address inflammatory and infectious conditions in the gut, using mechanically robust microencapsulation formats (coop. Research Group *Immuno-Materials*), and bladder disease, where magnetically responsive living therapeutic materials are being developed for localized intervention (coop. Research Department *Structure-Formation*, Dr. Johannes Linxweiler, UKS). In addition, our participation in the special priority programs (SPP2451 & SPP2494) of the DFG (German Research Foundation) expands our ELM work toward environmental remediation (coop. Dr. Meike Koenig, KIT) and biotechnological applications (coop. Prof. Marie Weinhart, LUH; Prof. Regine von Klitzing, TU Darmstadt). Together, these efforts consolidate our position at the intersection of materials science and synthetic biology, with ELMs tailored to specific biological contexts.

Dynamische Biomaterialien / Dynamic Biomaterials

Prof. Dr. Aránzazu del Campo

ZUSAMMENFASSUNG
Die Forschungsabteilung *Dynamische Biomaterialien* entwickelt bioaktive Materialien zur Einkapselung und Steuerung lebender Zellen. Mit unseren Kompetenzen in den Bereichen Hydrogelsynthese, Photoschalter, Biofabrikationstechnologien und Zellbiologie schaffen wir synthetische zelluläre Mikroumgebungen mit dynamischen Eigenschaften und untersuchen, wie lebende und nicht lebende Materie miteinander interagieren. Wir nutzen solche Wechselwirkungen, um Zellfunktionen durch angepasstes Materialdesign zu regulieren. In Zusammenarbeit mit synthetischen Biologen und Klinikern auf der ganzen Welt leisten wir einen Beitrag zum Bereich der lebenden therapeutischen Geräte für die dauerhafte und nachhaltige Behandlung chronischer Krankheiten, sowohl aus Sicht der Grundlagenforschung als auch aus Anwendungssicht. Wir koordinieren große Kooperationsinitiativen im Bereich der Engineered Living Materials.

MISSION
The Research Department *Dynamic Biomaterials* develops bioactive materials to encapsulate and instruct living cells. With our competences in hydrogel synthesis, photoswitches, biofabrication technologies, and cell biology, we create synthetic cellular microenvironments with dynamic properties and study how living and non-living matter interact. We exploit such interactions to regulate cellular functions by materials design. In cooperation with synthetic biologists and clinicians around the world, we contribute to the field of living therapeutic devices for sustained and sustainable treatment of chronic diseases, both from fundamental research and application perspectives. We coordinate large collaborative initiatives in the field of Engineered Living Materials.

CURRENT RESEARCH
Light-actuated interfaces triggering cellular responses
The regulation of the properties of biomaterials using light is at the core of our research. Using synthetic, light-driven rotary molecular motors (Fig. 1), we developed mechanically active hydrogels able to apply forces to membrane receptors at the cellular surface while tracking force-related cellular responses. With this material, we monitored and quantified protein recruitment, cytoskeletal organization, and cell traction force generation as a function of mechanostimulation and their reversibility in real time (Adv Sci 2026). This work was performed in cooperation with the Research Department *Interactive Surfaces*, the Georgia Tech University and the University Strasbourg (Leibniz-SAW Project LightAct).

Living Therapeutic Materials
The encapsulation of drug biofactories into implantable devices for long-term drug delivery is a major research topic in the group. These materials can sustain the release of biotherapeutics while containing the active

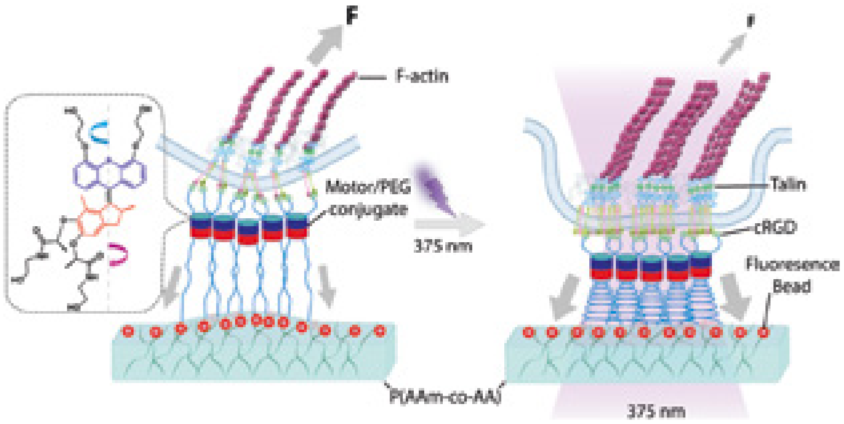


Fig. 1: Opto-actuated Hydrogel for cell mechanoregulation and real-time force monitoring.

organism long term. They support the on-site production of the drug using energy sources from the environment and represent new concepts for zero-waste pharmacology. We work on (i) understanding how material design affects bioactivity of biofactories, (ii) the design of material microarrays for parallelization of in vitro testing of living devices in simulated physiological conditions, and on (iii) the biofabrication of advanced prototypes for clinical translation. In this field, we cooperate with Research Groups *Bioprogrammable Materials* and *Materials-Host Interactions* (Biomat Adv 2025), and with several PIs at the Life Science and Medical Faculties of Saarland University. We focus our research on living materials for ocular drug delivery, with drug-eluting living contact lenses as advanced prototypes. Innovation steps based on this technology are supported by the Innovate Akademie (Joachim Herz Stiftung), goBio Initial (BMFTR) and a recently acquired SAW-Transfer funding in cooperation with the fiT-first-in-Translation facility at Leibniz-DWI in Aachen.
The department head coordinates the *Leibniz Science-Campus Living Therapeutic Materials*, in its second funding period from 2024 to 2028, and the DFG-funded Priority Programm *Engineered Living Materials with Adaptive Functions* (2024-2027). The group works in the digitalization of the Engineered Living Materials within a central project in the BMFTR-funded MaterialVital Hub. As reelected member of the review board, she supports the DFG Area Biomaterials (2024-28).

Materials for light management and optopharmacology
We develop soft hydrogel waveguides with customized side emission profiles for photo- and photothermal pharmacology inside the body (Adv Technol Mater, 2026). We apply multimaterial extrusion printing to integrate alternating segments of variable length with waveguiding, scattering or plasmonic functions along optical fibers. We cooperate with the Research Departments *Optical Materials* in the characterization of optical properties, and with *Structure Formation* in the use of gold nanorods for photothermal conversion. In cooperation with *Bioprogrammable Materials,* we incorporated optosensitive and thermosensitive biofactories into additional functional layers of printed optical fibers and realized new living device designs for optopharmacology.

OUTLOOK
The development of synthetic microenvironments for encapsulation and control of cell growth and function remains our major topic. Relevant upcoming effort will be devoted to technology transfer of living therapeutic ocular devices. Our growing effort in data-oriented experimentation will continue in collaborations with data science experts in MaterialVital Hub in the coming years. In the field of printed optical fibers, we envision devices with integrated sensing and self-glowing functions.

Elektrofluide / Electrofluids

Jun.-Prof. Dr. Lola González-García

ZUSAMMENFASSUNG

Die Forschungsgruppe *Elektrofluide* erforscht – gefördert vom European Research Council (ERC) ELECTROFLUID, Leitfähige Suspensionen für weiche Elektronik – flüssige Alternativen zu den herkömmlichen festen Metall- und Halbmetallmaterialien der Elektronik. Sie entwickelt damit elektronische Komponenten und robotische Aktuatoren für vollständig weiche Maschinen. "Elektrofluide" sind Suspensionen fester, leitfähiger Partikel, die Elektronentransport ermöglichen, wie Flüssigkeiten strömen und oft nicht-Newtonsches Verhalten zeigen, das wir ausnutzen. Abhängig von der Konzentration von Partikeln erreichen wir ausreichende Leitfähigkeiten. Elektrofluide können bei handhabbarer Viskosität transiente leitfähige Netzwerke bilden. Der Zusammenhang zwischen der Struktur und den rheoelektrischen Eigenschaften von Elektrofluiden steht im Mittelpunkt unserer Forschung. Die Gruppe untersucht die Wechselwirkungen von Partikel-Partikel-Reibung, Kontaktwiderstand, Perkolation, Volumenwiderstand und Suspensionsviskosität, um Ad-hoc-Elektrofluide für konkrete elektronische Anwendungsfälle zu entwickeln.

MISSION

The Research Group *Electrofluids*, funded by the ERC-Starting Grant ELECTROFLUID, Conductive suspension flows for soft electronics, investigates liquid alternatives to the traditional metal and semiconductor solid materials currently used in electronic components and robotic actuators to enable soft devices. “Electrofluids” (EFs) are suspensions of solid conductive particles that allow electron transport while flowing as liquids and often exhibit non-Newtonian behavior, which we also exploit. Depending on the concentrations of particles electrofluids can form transient conductive networks with manageable viscosity. The connection between structure and rheoelectrical properties of EFs is at the heart of our research. The group investigates the interplay between particle-particle friction, contact resistance, percolation, bulk resistance, and suspension viscosity to design *ad hoc* EFs for practical electronic applications.

CURRENT RESEARCH

Conductive emulsions with selective filler distribution as a volume exclusion strategy in electrofluids

Conductive polymer composites often rely on volume exclusion to lower the percolation threshold of conductive fillers. In our recent work, we examined how combining emulsions with conductive particles reduces the filler content required for electrical conductivity in EFs. We formulated conductive emulsions using two immiscible liquids, glycerol (dispersed phase) and polydimethylsiloxane (PDMS; continuous phase), with carbon black (CB) as the conductive filler. Structural analysis of stable emulsions revealed that CB preferentially localizes in the PDMS phase and accumulates around glycerol droplets. This selective arrangement enables the formation of an electrical network at lower filler concentrations, demonstrating the viability of volume exclusion as a strategy to decrease the percolation threshold in liquid systems. The coexistence of a CB network and dispersed glycerol droplets generated unexpected mechanoelectrical behavior. Compared to single-phase CB electrofluids, these emulsions exhibited reduced stiffness scaling and a suppression of strain thickening at elevated filler loadings. Through a detailed study of emulsion formation, droplet size, and droplet size distribution, we identified a dual role of CB: it participates in stabilizing the emulsion while simultaneously building a stress-bearing particle network. At large deformations, this network absorbs elastic energy that would otherwise be stored in droplet deformation, highlighting a synergistic interaction between the filler structure and the emulsion microarchitecture [Schmidt, et al., J. Phys. Mater., 2026].

Embedded 3D printing of electrofluids

Soft electrical components are vital for next-generation human-machine interfaces. Our EFs offer a soft, adaptable platform with tunable mechanoelectrical responses. Because they remain liquid during operation, encapsulation and fabricating complex geometries are challenging – but addressing these issues could open a wider range of applications.

After successfully applying direct ink writing (DIW) to manufacture carbon-based EFs (see Fig. 1) [Hautz et al., Adv. Mater. Technol. 2025], we now investigate the so-called Embedded 3D printing. Here, EFs are extruded within a bed of supporting material that, in a second step, will solidify, becoming the encapsulant. This strategy reduces the process steps and enables z-resolution in the printed patterns. We studied the rheological properties of the supporting material, evaluated the printing quality of different EFs in it, and made correlations between them. As a proof of concept, a proximity sensor was fabricated and connected through an Arduino unit to control a video game (see Fig. 2).

OUTLOOK

We will expand the *Electrofluids* portfolio by using metal fillers. The high intrinsic conductivity of silver will lead to better conductors; however, its high density represents a challenge for the formulation of stable suspensions. We plan to chemically modify the fillers´ surfaces to tune particle interactions.

Due to the use of high-value conductive fillers (silver particles and flakes), EF reutilization and particle recovery will be addressed to develop more sustainable EFs.

EFs containing 2D materials as conductive fillers will continue to be investigated. Graphene-like structures will be studied in collaboration with Dr. Claudia-F. Lopez-Camara, Assistant Professor at TU Eindhoven, and MXenes in collaboration with Prof. Volker Presser, *Energy Materials*, INM.

As part of EF integration and application, coaxial printing will be investigated as a manufacturing strategy to produce conductive fibers.

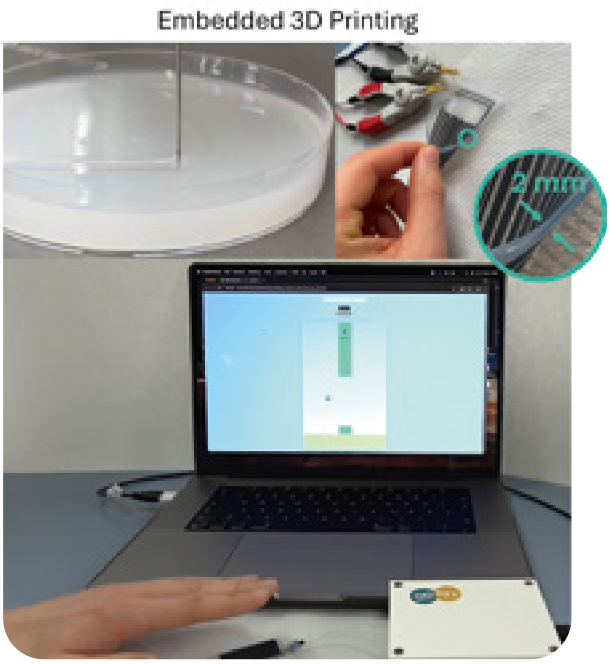


Fig. 1: 3D printed knob structure of a highly concentrated, carbon-based electrofluid enabling structural stability without cross-linking.
Fig. 2: Embedded 3D printing of an electrofluid. A highly flexible capacitive sensor functions as a proximity controller for a video game in which the height of the mascot is adjusted based on the distance between the player's hand and the sensor.

Energie-Materialien / Energy Materials

Prof. Dr. Volker Presser

ZUSAMMENFASSUNG
Die Forschungsabteilung *Energie-Materialien* entwickelt elektrochemische Materialien und Gerätekonzepte für Energiespeicherung, Wassertechnologien und umweltfreundliches Recycling verbrauchter Batterien. Wir gestalten nanostrukturierte Elektroden und Grenzflächen, die Ionentransport und Ladungsspeicherung gezielt steuern, und überführen sie in robuste Zellen und Durchfluss-Module. Unsere Arbeit verbindet skalierbare Synthese und Verarbeitung mit fortgeschrittener Charakterisierung, In-situ/Operando-Elektrochemie und datengestützter Analyse. Durch Partnerschaften innerhalb des INM sowie mit Wissenschaft und Industrie entwickeln wir praxistaugliche Lösungen für nachhaltige Energiespeicherung, Wasseraufbereitung und die Rückgewinnung kritischer Elemente.

MISSION
The Research Department *Energy Materials* develops electrochemical materials and device concepts for energy storage, water technologies, and eco-friendly recycling of spent batteries. We design nanostructured electrodes and interfaces that control ion transport and charge storage, and we translate them into robust cells and flow modules. Our work combines scalable synthesis and processing with advanced characterization, in-situ/operando electrochemistry, and data-supported analysis. By partnering across INM and with academia and industry, we develop practical solutions for sustainable energy storage, water treatment, and critical element recovery.

CURRENT RESEARCH
Electrochemical ion separation and recovery
Electrochemical interfaces underpin both energy storage and advanced water technologies. We develop ion-selective electrodes to recover valuable ions and remove undesired species from complex aqueous streams, using abundant carbon nanomaterials, cost-effective metal oxides, and interlayer-functionalized 2D nanostructures. A key design lever is nanoconfinement, for example, by tailoring MXene interlayer spacing to favor Li+ over competing ions (Kök et al., ACS Energy Lett., 2026). In parallel, we advance sustainable battery recycling and electrochemical recycling concepts through energy-efficient lithium recovery from real leachates and spent cathodes (Arnold et al., Sep. Purif. Technol., 2025; Arnold and Presser, Energy Adv., 2025) and translate these concepts within the ongoing EFRE project eLiFlow into continuous processes. Newly, we extended our platform to selective rare earth element recovery from aqueous solutions (DFG project SELLEREE). Close academic and industrial contacts envision scalability and real-world impact.

Advanced batteries toward sustainability
Developing next-generation batteries is central to our mission, targeting higher performance, longer lifetime, improved recyclability, and reduced reliance on critical raw materials. Within M-ERA.NET ALISA, we advance lithium-sulfur cells based on nanoporous carbon hosts and Li-ion-compatible carbonate electrolytes and clarify rate and capacity limitations using operando methods (Tarimo et al., ACS Appl. Energy Mater., 2025). Beyond Li-S, we expand into room-temperature sodium-sulfur chemistries, where oxide sub-nanoclusters enable regulated sulfur conversion and long-term cycling stability (Wu et al., Adv. Mater., 2025).
Being based on carbon and iron, the Austrian-German DFG project SPHEROGELS has enabled us to develop eco-friendly and high-performance lithium-ion battery electrodes. We also adopt novel and established materials for more sustainable electrode processing. For example, we utilize solvent-free dry processing to achieve higher performance and lower energy consumption and use of chemicals during electrode fabrication (Pameté et al., Energy Environ. Mater., 2025). In addition, we explore non-fluorine containing, green binder materials for batteries. We also work directly with industry partners to develop high-performance lithium-ion anodes for next-generation battery designs.

OUTLOOK

Our electrochemical materials and devices will be advanced toward optimized ion-selective interfaces for water purification and resource recovery alongside our work on beyond-lithium energy storage. We will strengthen sulfur-based chemistries in both lithium-sulfur and sodium-sulfur cells and explore nickel-based battery concepts as complementary, materials-secure options. Advancing our activities related to sustainability, we develop particulate electrode recovery and recycling technologies together with key partners, including research department *Structure Formation*. Data-supported analysis will help shorten iteration cycles by connecting microstructure, processing, and performance, while sustainability metrics guide material selection and energy-efficient synthesis. Overall, our goal is to gain scalable electrochemical systems with high selectivity, long lifetime, and a measurably lower environmental footprint.

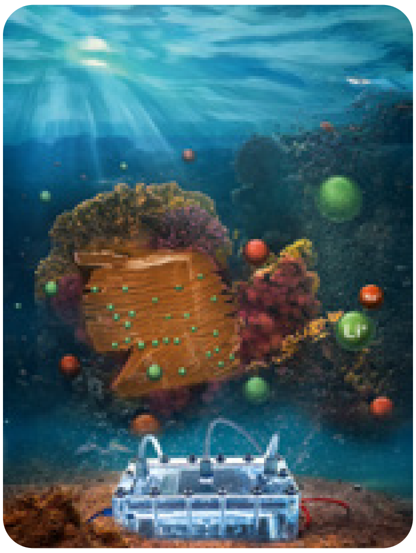


Fig. 1: Electrochemical lithium-ion recovery with interlayer-modified MXene.
Fig. 2: High-performance lithium-ion batteries based on iron-loaded carbon spherogels.

Immuno-Materialien / Immuno Materials

Dr. Oskar Staufer

ZUSAMMENFASSUNG

Die Forschungsgruppe *Immun-Materialien* ist Teil der pharmazeutischen Forschungsallianz Saarland und wird seit November 2023 durch das Emmy-Noether-Programm der Deutschen Forschungsgemeinschaft gefördert. Sie vereint Expertise aus der Bottom-up-synthetischen Biologie und der zellulären Immunologie mit dem Ziel, neuartige Biomaterialien für immuntherapeutische Anwendungen zu entwickeln. Ein zentraler Fokus liegt auf biomimetischen Materialien zur gezielten Aktivierung von Immunzellen sowie auf der Entwicklung innovativer Methoden zur Erfassung physikalischer und chemischer Signale in der Tumormikroumgebung.
In diesem Kontext wurden emulsionsbasierte künstliche Immunzellen entwickelt und zu künstlichen Geweben in Form synthetischer Lymphknoten weiterentwickelt. Darüber hinaus etablierte die Gruppe 3D-Hybrid-Zellkultursysteme zur Untersuchung von Krebs-Immuninteraktionen in Pankreastumoren.

MISSION

The Emmy-Noether funded research group designs and engineers emulsion-based biomimetic materials to create synthetic cell components, with the goal of advancing immunological insight and enabling novel therapeutic strategies. By combining synthetic lipids, emulsions, and inorganic silica colloidosomes with living T cells and cancer cells, we establish functional biohybrid systems at the interface of living and non-living matter, covering length scales from molecular assemblies to tissue-like constructs.

CURRENT WORK

In 2025, our research achieved major advances in three key areas: (1) the generation of hybrid organoids combining synthetic and living cells; (2) the formation of synthetic cell-based tissues for the ex vivo expansion of T cells; and (3) the development of micropatterned confinement systems for the culture and differentiation of hematopoietic stem cells. Across these projects, we applied our droplet-supported lipid bilayer technology, an advanced synthetic cell platform that mimics the biochemical and mechanical properties of immune cells. In the first line of work, synthetic cells were used to uncover previously unknown functional mechanisms underlying immune evasion in pancreatic cancer and to assess their relevance for bispecific T cell engager therapy. This study was published in 2025 (Pierntzki et al., Nature Communications) and conducted through an international collaboration with the University of Bristol (UK), Semmelweis University (Hungary), and Saarland University. In the second project, synthetic cells were employed to engineer artificial tissues with tunable structural and functional properties. This work, also published in 2025 (Burgstaller et al., Advanced Healthcare Materials), enabled the *ex vivo* activation and expansion of regulatory T cells, a critical cell type for the treatment of autoimmune diseases. The study was carried out in collaboration with Saarland University.

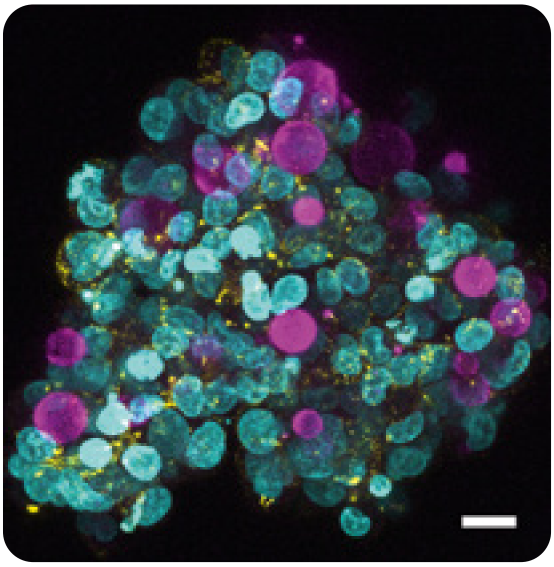


Fig. 1: Fluorescence microscopy image of a hybrid pancreatic cancer 3D culture with integrated synthetic immune cells (magenta). The nuclei of the cancer cells are stained in cyan.

Finally, we developed micropillar-based systems using soft lithography, supported by an internal collaboration with the research department *Structure Formation*, to fabricate elastomer-based nanowells for hematopoietic stem cell culture. We further integrated synthetic cells into these systems, representing an important step towards replacing living feeder cells, which constitute a major cost and variability factor in current stem cell culture platforms.

OUTLOOK

Our research is moving towards the further development of artificial cell systems for the controlled stimulation and modulation of immunological environments *in vitro*. This strategy aims to reveal key signaling mechanisms within tumor immune microenvironments and to elucidate their responses to immunotherapeutic interventions. A major focus will be the advancement of 3D-printed tissue constructs and their integration with automation pipelines, paving the way for novel, systematic drug-screening approaches in immunotherapy. In parallel, we will apply synthetic cells to quantify force distributions in 3D cancer models, providing new insights into the biophysical foundations of cancer therapy resistance. We will also leverage our expertise in lipid membrane engineering to deepen our understanding of exosome signaling in cancer and the biophysical mechanisms governing cancer–immune interactions. Furthermore, we plan to integrate chemically active and switchable components, such as enzymes and photo-switchable polymers, into our synthetic cell systems to enhance the dynamic responsiveness of the cell-mimicking materials we create. Ultimately, our research aims to use artificial cell systems to generate novel insights into cancer therapy and drug resistance, contributing to the development of more personalized and effective treatment strategies.

Interaktive Oberflächen / Interactive Surfaces

Prof. Dr. Roland Bennewitz

ZUSAMMENFASSUNG

Die Forschungsabteilung *Interaktive Oberflächen* untersucht die mechanischen Eigenschaften von Materialien wie Reibung und Adhäsion und setzt sie in praktische Anwendungen um. Dazu nutzt die Gruppe die Strukturierung und Funktionalisierung von Oberflächen in Verbindung mit einem Verständnis physikalisch-chemischer Mechanismen. Die Interaktionen an Oberflächen werden für Biomaterialien wie Hydrogele oder für mikrostrukturierte Elastomere untersucht. Die Projekte basieren auf unserer Expertise in der experimentellen Nanomechanik und psychophysikalischen Experimenten im Bereich der haptischen Wahrnehmung von Materialien. Zu den wichtigsten Ergebnissen des Jahres 2025 gehört eine Studie zur Bedeutung der physiologischen Parameter der Haut in der Berührung von Materialien. Außerdem wurde gezeigt, wie sich die Viskosität auf die Reibung beim Verstreichen von Flüssigkeiten mit dem Finger auswirkt und welche Rolle das für eine angenehme oder unangenehme Wahrnehmung spielt.

MISSION

The Research Department *Interactive Surfaces* explores new materials with specific adhesion and friction properties and investigates the function of surface materials in haptics. We focus on molecular functionalization and structuring at the micrometer scale and investigate the physical chemistry of friction, wear, lubrication, deformation, and adhesion as well as the role of sliding friction in tactile perception. Materials of interest range from hydrogels to additively manufactured microstructures and materials with switchable roughness. The projects draw on our expertise in experimental nanomechanics and novel tactile perception experiments. Single-molecule force spectroscopy is used in soft matter for biophysical applications.

CURRENT RESEARCH

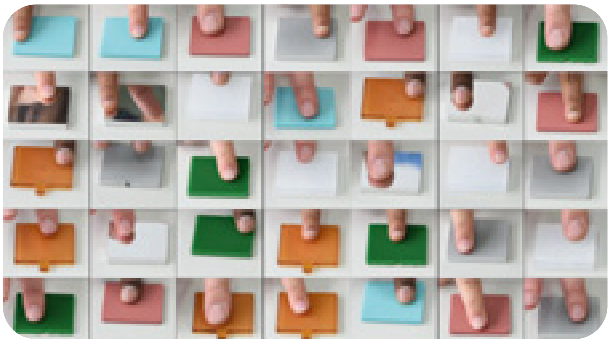
Nanoscale conduction measurements on hybrid materials

Thin films of hybrid nanoparticles made of metal cores and conductive polymer shells have been established as new material for flexible electronics. These materials can be prepared as inks and printed into electrical circuits. Their functionality depends critically on the percolation of electrical conductivity across the network of nanoparticles. In collaboration with the Research Department *Structure Formation*, we have applied conductive atomic force microscopy (cAFM) to identify local networks of electrical conductance for different thin film preparations. We discovered how local clusters of nanoparticles provide excellent conductance, while high-resistance bridges between clusters limit the conductivity of the film in particular in quasi two-dimensional assemblies of nanoparticles (Das *et al*., Nanoscale 2026).

Physiology and the tactile perception of materials
In a large collaborative project supported by the *Volkswagen Foundation*, we explore materials for the future of tactile communication. A challenge in the preparation of materials with dedicated haptic appeal are variations in the skin-material interactions which arise from individual differences in the skin physiology. In collaboration with the *Center of Experimental and Applied Cutaneous Physiology* at the *Charité University Hospital* in Berlin, we explored the role of skin hydration, skin deformability, and age in tactile friction and perception of materials. Based on results for a large group of participants, we revealed which materials and structural properties cause a strong dependence on skin hydration and how the decrease in the density of mechanoreceptors with increasing age affects materials perception (Infante et al., Scientific Reports 2025).

ONGOING PROJECTS
In our nanomechanics projects, we will explore mechanisms of friction and adhesion on hydrogels and biomaterials by force spectroscopy and friction measurements on length scales ranging from individual polymer chains to full biofilms. We image nano-scale structures such as micelles in hydrogels produced by the Research Department *Dynamic Biomaterials* and investigate nano-scale interactions on contact lens materials with them. Exploring materials for the future of tactile communication, our project, supported by the *Volkswagen Foundation*, investigates the tactile stimulus of switchable surface roughness by MEG experiments and explores the role of thermal conductivity in the perception of pleasantness. A new DFG-funded project is dedicated to the concept of "surface softness", i.e. the perception of softness when stroking a surface laterally.

OUTLOOK
We will continue to investigate the mechanisms that link the structure and dynamics of surfaces to adhesion, friction, and wear in novel materials. Our efforts will address soft matter as biological and medical materials, where we will employ nanomechanical methods to investigate the role of phase separation, polymer entanglement, molecular stretching, and the physical chemistry of bond formation and rupture.
Our research on the haptics of materials will focus on surface softness and include cross-modal perception with visual and auditory cues. We will expand our efforts to predict the role of individual differences in the tactile perception of materials.



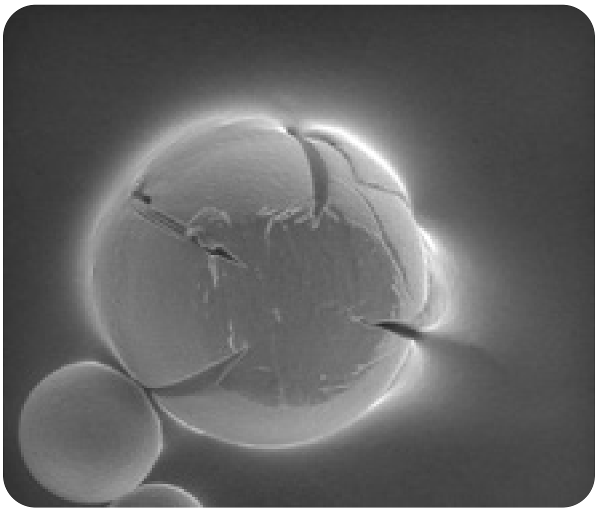


Fig. 1: Tactile perception depends on skin-material interactions which vary for some, but not all materials with individual physiological differences.

Fig. 2: Nanomechanics explores the relation between mechanical responses at small scale and the function of materials.

Materialien-Host Interaktionen / Materials-Host Interactions

Dr. Sara Trujillo

ZUSAMMENFASSUNG

Die Forschungsgruppe *Materialien-Host Interaktionen* erforscht, wie sich Biomaterialienbasierte Therapien auf Zellen und Gewebe auswirken. Sie konzentriert sich auf die Entwicklung von Gewebemodellen und Methoden, mit denen Sicherheit und Wirksamkeit der neuen Therapien bestimmt werden können. Wir wenden komplexe Kulturtechniken wie 3D-Gewebe auf Organ-on-Chip-Modelle an und validieren die in vitro erzielten Ergebnisse anhand von in vivo-Modellen. Unser Schwerpunkt liegt auf biologischen Barrieren wie der Haut, der Hornhaut und dem Endothel. Im Bereich der biomaterialbasierten Therapien arbeiten wir an lebenden therapeutischen Materialien. Diese Materialklasse stellt uns vor Herausforderungen wie die dynamische Leistungsfähigkeit im Zeitverlauf und Sicherheitsrisiken, denen wir uns stellen wollen.

MISSION

The Research Group *Materials-Host Interactions* explores how biomaterials-based therapies affect cells and tissues. It focusses on the development of tissue models and methodologies for determining safety and efficacy of these new therapies. We apply complex culture techniques such as 3D-tissue on organ-on-chip models and validate results in vivo. We focus on biological barriers such as skin, cornea and endothelium. Among biomaterial-based therapies, we work on living therapeutic materials. This materials class presents challenges such as dynamic performance over time and safety risks that we aim to tackle.

CURRENT WORK

We are investigating the immunomodulatory effects of living materials secreting anti-inflammatory peptides in cooperation with the Research Group *Bioprogrammable Materials*. For this, we developed an in vitro model of endotoxemia using engineered macrophages. The cooperation resulted in a publication this year [Deshpande et al., ACS Pharmacol. Transl. Sci., 2025]. This cooperation aimed at understanding more about these drug delivery devices on the skin, an important immunological barrier, for which we are developing a model of psoriasis. Further cooperation with the Research Group *Bioprogrammable Materials* has involved the application of our in vitro and in vivo models designed for the study of angiogenesis like chick chorioallantoic membrane assay and other endothelial-based models. The results of this cooperation are published as a preprint [Chatterjee et al., BioRxiv, 2025].

We are advancing our models to investigate ophthalmic drug delivery in cooperation with Research Department *Dynamic Biomaterials*. For this, we apply an in vitro model of corneal epithelium using complex air-liquid interface culture for the study of living materials applied to the eye [Desai et al., Adv. Healthcare Mater., 2025]. For this, we mimicked extended wear on the eye, proving that the living material applied did not trigger any inflammatory reaction during application.

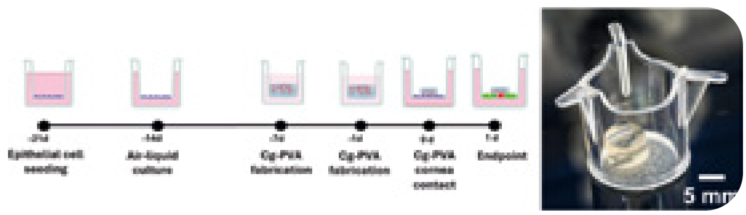
We performed first co-cultures of living materials and our tissue models and put living materials in direct contact with our tissue models performing the first murine pilot study of implantable living materials in cooperation with Experimental Surgery group (University of Saarland). This marked a new milestone achieved on the pre-clinical assessment of this class of biomaterials within the Leibniz Science Campus.

We continue advancing on our corneal models by developing methodologies to fabricate human cornea-on-chip, being carried out with support from Dr Rolf Schwiete Foundation [S. Trujillo, Adv. Therap., 2025]. On the topic of ocular models, we have developed a model of dry eye disease to investigate various therapies. Dry eye disease mechanobiology is investigated in cooperation with the Cantini group (University of Glasgow, UK). This work applied nanoindentation measurements using atomic force microscopy on healthy and dry eye disease models together with the investigation of changes in cell-cell, cell-extracellular matrix adhesions and the expression of various mechanosensing markers, aimed to discover new therapeutic targets for the disease.

Finally, in cooperation with Research Group *Electrofluids* and the Macromolecular Engineering group (Institute of Science and Polymer Technology, Spain), we investigated the host response of chitosan-based scaffolds, for which we applied our endotoxemia models [Muñoz-Nuñez et al., Carbohydr. Polym. Technol. Appl., 2025]. These scaffolds were designed to have tuneable physicochemical and antimicrobial properties, and we studied host response.

OUTLOOK

Our tools and methodologies are designed to assay biomaterial-based therapies or drug delivery systems in vitro and to be adaptable to the requirements of the biomaterial. With our advanced knowledge on how to co-culturing materials with tissue models, we aim to model the eye microbiome using organ-on-chip technologies, within a DFG funded project. The realization of our psoriatic model will help in the understanding of new biomaterial-based therapies for the disease.



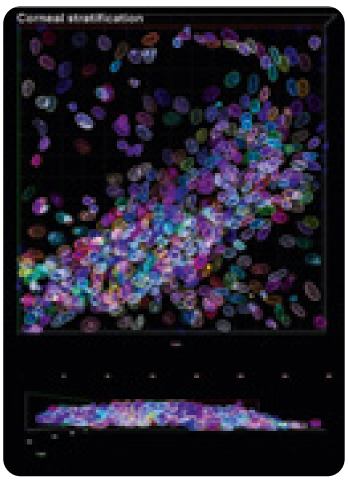


Fig. 1: Schematic on direct co-culture of differentiated corneal epithelium at the air-liquid interface and a living material. Macroscopic image of the co-culture.

Fig. 2: Confocal 3D images of stratified corneal cells. The coloured outlines represent cell identification from a supervised machine learning process to quantify the stratification efficiency.

Materialorientierte Synthetische Biologie / Materials Synthetic Biology

Prof. Dr. Wilfried Weber

ZUSAMMENFASSUNG

Die Forschungsabteilung *Materialorientierte Synthetische Biologie* entwickelt Zellen und Materialien die Informationen austauschen und verarbeiten mittels Synthetischer Biologie. Im Mittelpunkt unserer Arbeit steht die funktionelle Integration synthetisch-biologischer Sensoren und Schalter in polymere oder anorganische Materialsysteme sowie deren Verknüpfung miteinander. Einen besonderen Schwerpunkt bildet die molekulare Optogenetik, die es ermöglicht, Zellen und Materialien über Licht mit hoher räumlicher und zeitlicher Präzision zu programmieren. Um die Materialentwicklung zu beschleunigen, verwenden wir automatisierte Laborprozesse und Daten-getriebene Vorhersagen.
Unsere Forschung konzentriert sich auf drei Anwendungsfelder: (i) selbstregulierende oder extern steuerbare Depots für die kontrollierte Freisetzung von Wirkstoffen, (ii) molekulare Sensoren, um Medikamente oder Umweltkontaminanten mit hoher Spezifität zu detektieren und (iii) 3D-programmierbare, lebende Konstruktionsmaterialien, die biologische Funktionalität mit strukturellen Eigenschaften vereinen.

MISSION

The Research Department *Materials Synthetic Biology* department advances the design and development of cells and materials that can communicate and process information through synthetic biology. Our work centers on functionally integrating synthetic biology–derived sensors and switches with polymeric or inorganic material platforms. A major emphasis is placed on molecular optogenetics, which enables the precise programming of cellular and material functions through light-based control, offering exceptional spatial and temporal resolution. To guide the development of these systems, we employ automated processes and data-driven predictions.
Our research activities converge on three application areas: we develop (i) self-regulated or externally triggered drug-delivery depots, (ii) molecular sensors to detect pharmaceuticals or environmental pollutants, and (iii) 3D-programmable, living construction materials that combine biological functions structural features in an overall sustainable framework.

CURRENT RESEARCH

Our inspiration is the ability of organisms and the materials they are made of to adapt to dynamic environmental conditions. This adaptivity is based on the cells' ability to sense environmental information, to process and integrate this information with genetic programs, and to finally produce a targeted response. In our research, we engineer nature's molecular sensing, processing, and actuation machinery to precisely control the function and properties of cells and materials. We applied these newly developed technologies in complementary fields of research.

Light-responsive intracellular assemblies to control information processing in mammalian cells.
Cells rely on organized assemblies of proteins to process information. In order to control these processes,

we apply molecular optogenetics to tune the formation of these assemblies by light. We demonstrated that the blue light-inducible assembly of key information-transducing proteins in the immune reaction-related so-called NF-κB pathway allowed its precise activation. The activation was reversible and tunable, allowing controlled temporal modulation of information processing. RNA-sequencing confirmed that blue-light stimulation triggered a defined set of endogenous NF-κB target genes, demonstrating that the system reproduces key features of physiological pathway activation. This work demonstrates how intracellular, light-responsive supramolecular assemblies can be precisely controlled. This enables systematic examination of how the organization, density, and phase behavior of protein complexes influence biochemical outputs. (*Fischer et al., Advanced Biology 2025*, Figure 1).

Engineering molecular sensor materials and devices
How biological systems sense and respond to their chemical environment provides guiding principles for the design of adaptive materials. The study described synthetic organelles formed by liquid–liquid phase separation of a DNA-binding protein. DNA sequestration within the coacervates resulted in strong attenuation of transcription, while the trigger-inducible release of DNA induced a dose-dependent recovery of transcriptional activity. This work establishes a modular platform for designing adaptive, compartmentalized reaction environments and illustrates the potential of synthetic biology to expand the toolkit for responsive and programmable materials. (*Jerez-Longres and Wilfried Weber, ACS Synthetic Biology 2025*).

Living Construction Materials
In the newly granted, Volkswagen Stiftung-funded consortium led by the University of Stuttgart as well as in the European Innovation Council-funded consortium LoopOfFun that is coordinated by our department, we collaborate to develop biodegradable mycelium-based composite materials for the construction industry. Our focus is on the development of synthetic biology methods to tune the material properties of mycelium-based materials in such a way that they meet the requirements for various building material classes that have not yet been achievable. (Figure 2).

OUTLOOK
In our future research we will continue to work on both, fundamental and application-driven research on bio-based and living materials. Whereas the work around the ERC Advanced Grant STEADY will focus on developing fundamental design rules for living materials and establishing gene-material correlations, we will in parallel strive towards promoting our research towards application in the context of structural and functional ELMs with application fields in construction, biosensing, or therapeutics.

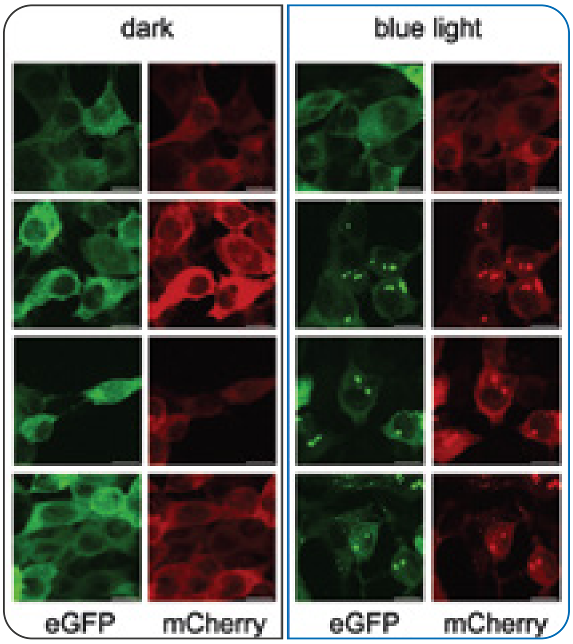


Fig. 1: Blue light-inducible formation of clusters of the kinase IKK in mammalian cells. The proteins have been fused to the green (eGFP) fluorescent protein to follow clustering.

Fig. 2: Mycelium-based composite from the LoopOfFun project. Organic waste was bound to a composite by mycelium-based fibers acting as binder.

Optische Materialien / Optical Materials

Dr. Peter W. de Oliveira

ZUSAMMENFASSUNG

Die anwendungsorientierte Forschungsabteilung *Optische Materialien* (OM) befasst sich mit der Erforschung von Metamaterialien, Beschichtungsverfahren und Bauelementen für Optik und Elektrooptik. Ausgehend von der Grundlagenforschung zielt unsere Forschung auf Technologiereifegrade oberhalb von Stufe 5. Ziel ist es, durch gezielte Anpassung physikalischer und chemischer Eigenschaften von Strukturmaterialien eine präzise Wechselwirkung mit Licht zu erreichen. In 2025 wurde unter anderem an der Entwicklung einer leitfähigen, weißen Beschichtung für Raumfahrzeuge gearbeitet, glasartige Schichten zu Beschichtungen mit speziellen Eigenschaften als Sperre für Wasserstoffdiffusion weiterentwickelt und energieeffiziente Prozesse zur Härtung von Interferenzschichtpaketen etabliert. Die Arbeiten der Abteilung gehen von der Grundlagenforschung aus und streben stets eine Validierungsorientierung in enger Zusammenarbeit mit Wissenschaft, Industrie und insbesondere mit kleinen und mittleren Unternehmen (KMU) an.

MISSION

The application-oriented research department *Optical Materials* (OM) has the mission to develop metamaterials, coating processes and components for optical and electro-optical applications. Starting from fundamental research, our research targets TRLs above 5 and the implementation in viable products. We tailor materials for interactions with light through adapted physical and chemical properties of structural materials.

We work with inorganic, organic or inorganic-organic hybrid materials which are structured by incorporating nano entities and using techniques such as coating or embossing. Expertise comprises the modeling of opto-electronic components, the synthesis of hybrid matrices using wet-chemical processes, and the production of chemically modified nanoparticles. This integrated skills set enables the development of novel materials with tailored physical properties, such as refractive index or conductivity. The department validates research in cooperation with industry and especially small and medium-sized enterprises (SME).

CURRENT RESEARCH

Optical interference coatings via energy-efficient StackCure process

Wet-chemical sol-gel multilayer interference filter systems are manufactured by repetitive cycles of layer deposition and curing at high temperatures. Within ZIM project *StackCure* an innovative manufacturing process was developed where the subsequent applied layers are only dried at low temperatures, with a final cure at 480 °C. As long as stacking remains below a critical layer thickness limit crack formation can be avoided. The industrial partner has already successfully implemented the *StackCure* process in the production of 5-layer yellow filters, achieving a reduction of energy consumption of 63% compared to the conventional production method (ZIM project).

Barrier Coatings for Robust Hydrogen Pressure Sensors

Pressure sensors for hydrogen pressure vessels rely on the deformation of thin steel membranes measured by piezoresistive elements sensitive to hydrogen permeation. Glass like sol-gel coatings based on potassium silicate and SiO_2/TiO_2-particles were developed to enhance the barrier properties of the 0.2 mm thick steel membranes. The barrier coatings showed excellent adhesion and long term corrosion protection and no-permeation observed. Long term high-pressure and high-temperature tests with coated steel foils are currently ongoing to validate durability under extreme operational conditions. This project was funded by the “National Innovation Program Hydrogen and Fuel Cell Technology” (BMFTR).

Conductive White Coating For Extreme Environments

Conductive white coatings protect sensitive surfaces of spacecrafts and dissipate electrical charges caused by space environment. OM has developed a sprayable ambient-curable coating based on a silicone resin binder filled with high-refractive-index scattering particles and conductive fillers. The coating needs to have a final thickness of 30 µm to 50 µm, a solar absorption $\alpha < 0.15$, a resistance $R_{sq} < 106\ \Omega/sq$ and a TRL = 6 to be demonstrated on breadboard model. Current development uses rutile (TiO_2) as white filler and single-walled carbon nanotubes as conductive material. (Industrial cooperation)

OUTLOOK

The research and development focus of the *Optical Materials* department until 2029 will center on novel materials with tailored optical properties for application. In addition, biological aspects are gaining increasing relevance in our material's development, for example in the design of biologically driven self-organizing coatings.

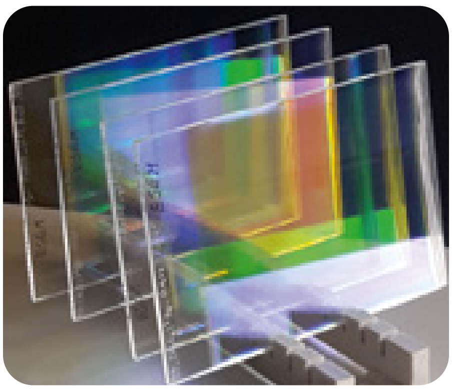


Fig. 1: Samples of different interference filters obtained by the StackCure Process
Fig. 2: Labsamples of H2 pressure sensor monocells coated with novel glass based barrierlayer

Strukturbildung / Structure Formation

Prof. Dr. Tobias Kraus

ZUSAMMENFASSUNG

Die Forschungsabteilung *Strukturbildung* untersucht, wie sich dispergierte Partikel und Moleküle zu funktionalen Materialien zusammenfügen. Mithilfe von Streuung, Mikroskopie, systematischer chemischer Variation sowie in situ-Beobachtung klären wir Wechselwirkungen in komplexen Materialvorstufen auf. Durch gezielte Anpassung molekularer Grenzflächen, lokaler Geometrie und hierarchischer Struktur verändern wir mechanische, elektrische und optische Materialeigenschaften. Grenzflächen werden so gestaltet, dass sie die spätere Trennung von Komponenten im Recycling erleichtern. So gewonnenes Verständnis ermöglicht uns, Materialien für weiche Elektronik, Robotik, Optik und Sensorik auf Längenskalen von Nanometern bis Millimetern gezielt zu strukturieren. Dazu entwickeln wir ressourceneffiziente Synthese- und Verarbeitungsprozesse nahe Raumtemperatur und an Luft. Ziel sind multifunktionale und langlebige Materialien mit „Recyclability by Design", die sich am Ende ihrer Lebensdauer in wieder nutzbare Bausteine zerlegen lassen.

MISSION

The Research Department *Structure Formation* investigates how dispersed particles and molecules assemble into functional materials. Using scattering, microscopy, systematic chemical variation, and in situ observation, we elucidate interactions in complex material precursors. By tailoring molecular interfaces, local geometries, and hierarchical structures, we tune mechanical, electrical, and optical properties. Interfaces are introduced to facilitate the separation of components during recycling. Our insights enable design of materials for soft electronics, robotics, optics, and sensors at various length scales. We develop resource-efficient synthesis processes near room temperature and in air, aiming for multifunctional, durable materials recyclable by design.

CURRENT RESEARCH

Efficiency and stability of soft printed conductors for sensors and wearables

Soft electronics, wearables, and sensors rely on conductive materials withstanding repeated deformation. Today, silver-filled conductive polymer composites (CPCs) dominate this field, combining conductivity with mechanical compliance but requiring high silver contents making them costly, environmentally harmful, motivating alternative design strategies.

In 2025, we clarified what determines conductivity in CPCs. Our results (*Perius et al., Small Structures, 2025*) show that electrical transport is mainly controlled by the quality of particle–particle contacts. Notably, a large proportion of silver in conventional CPCs does not contribute to conductivity, thus enabling equally conductive but more resource-efficient materials. We adressed conductivity losses under cyclic deformation and identified hybrid composites made of silver and carbon-based conductors as particularly stable. In parallel, we advance technology transfer and develop conductive pastes for printed stretchable interconnects, heating elements, and temperature sensors.

Optical sensor material for mercury for integration into biomimetic "seeds"
Mercury contamination is widespread but difficult to detect due to its highly localized distribution in soils. In the EU-funded project I-Seed, we are pursuing a new sensing strategy based on biomimetic "seeds" that are dispersed by the wind over large areas (*Nexha et al., Nanoscale, 2025*). In collaboration with Prof. Barbara Mazzolai (IIT), we have developed lightweight optical sensor materials for mercury detection consisting of multilayers in which combining plasmonic gold nanoparticles with upconverting rare-earth-doped nanoparticles. They selectively absorb mercury with a change in optical emission. When excited in the near-infrared range, they emit visible light whose color reflects the amount of mercury absorbed, enabling easy remote readout. Together with industry partners, we are developing this approach as cost-effective alternative to conventional spectroscopic mercury sensing.

New ways to incorporate nanoparticle into materials
Nanoparticles are key components of many materials and usually kept dispersed, a challenge we have been addressed for a long time. We showed that disordered organic shells enhance dispersion stability (*Knapp et al., ACS Nano, 2025*). However, some applications require electrical connections between the particles. Instead of high-temperature sintering, we use chemical processes for particle fusion under mild conditions. Small cyclic thiols can induce the fusion of gold nanoparticles at moderate temperatures, while amines cannot displace the original ligands. This enables inks that remain stable during printing process only activated by mild heating, allowing gentle sintering as needed.

Combining bacteria with nanoparticles: living plasmonics
Genetically modified E. coli bacteria are highly selective chemical sensors, but generate weak optical signals, whereas plasmonic gold nanoparticles exhibit intense colours even in low concentrations. In the DFG-funded project Living Plasmonics, which is part of a DFG Priority Program coordinated by INM, we combine both. To overcome major challenges posed by the incompatible requirements of nanoparticle formation and bacterial viability, we used extensive parallel experiments and collaborated closely with *Materials Synthetic Biology* to develop hybrid living–plasmonic sensor materials.

OUTLOOK
The stable, stretchable CPCs developed based on our findings outperform commercially available materials. Together with INM's Technology Transfer Department, we are evaluating ways to commercialize them. As described above, we are researching new CPC designs with reduced silver content. A DBU-funded project with an SME starting in 2026 will translate these concepts into printable materials. At the same time, we are refining soft, printable sensor materials being lightweight, non-toxic, and easy to use, while offering sensor functions that previously reed electronics. Progress will be supported by new X-ray scattering and electron microscopy techniques to be established in the coming years.

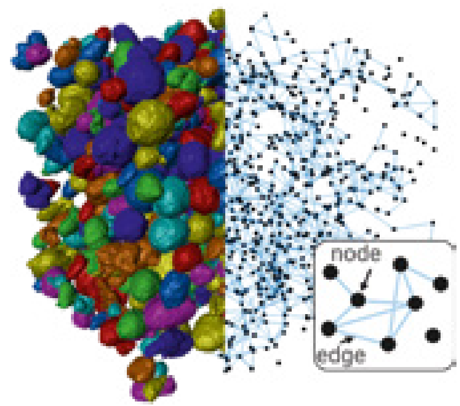


Fig. 1: Reconstructed network of silver particles in a soft conductor. The analysis shows that contact resistances dominate the conductivity and that most of the silver does not contribute to it.

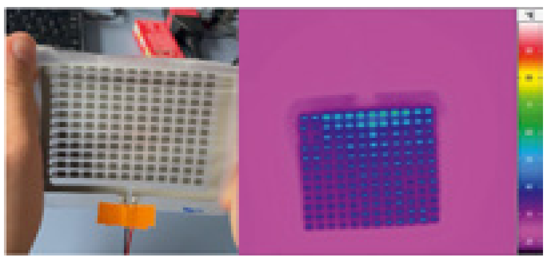


Fig. 2: A printed, stretchable heating elements based on a new conductive polymer composite retains its conductivity and keeps heating, even after many deformation cycles.

InnovationsZentrum INM / InnovationCenter INM

Dr. Carsten Becker-Willinger, Dr. Peter W. de Oliveira

ZUSAMMENFASSUNG

Das *InnovationsZentrum INM* bildet die Schnittstelle zwischen den wissenschaftlichen Einheiten des Instituts und der Industrie. Gemeinsam mit den wissenschaftlichen Einheiten werden Strategien erarbeitet, wie der Technologiereifegrad der Grundlagenentwicklungen gezielt auf ein Niveau angehoben werden kann, das den Einstieg in eine Industriekooperation ermöglicht. Im Rahmen dieser Projekte übernimmt das *InnovationsZentrum* die Skalierung von Synthesen auf den Pilotmaßstab sowie die materialbezogene Optimierung von Produktionsprozessen. Marktanalysen und die Identifizierung von Projektpartnern aus der Industrie werden mit Unterstützung externer Beratungsunternehmen durchgeführt. Um das *InnovationsZentrum INM* zu stärken, werden Technologietransferstrategien verbessert und die existierende Infrastruktur renoviert.

Dr. Carsten Becker-Willinger

Dr. Peter W. de Oliveira

MISSION

The *InnovationCenter INM* forms the interface between the institute's scientific units and industry. It supports the scientific units to raise the technological maturity of new materials to a level that enables entry into industrial cooperation. Within the framework of these projects, the *InnovationCenter INM* is responsible for scaling syntheses to pilot scale and for the material-related optimization of production processes. Market analyses and the identification of project partners at the industry is performed with support from external consultants. To strengthen the *InnovationCenter INM*, INM is reinforcing its technology transfer strategies and renovating the existing infrastructure.

CURRENT RESEARCH & DEVELOPMENT

In an industry project sustainable inorganic binders are optimized for replacement of cement in classical cement bonded wood fiber boards used in construction. The material is optimized for the use in a slab press ultimately enabling mass production of large-area boards. Currently upscaling, process optimization and plant engineering are performed in collaboration with the end-user and its equipment manufacturer.

In another industry the up-scaling of a sol-gel process for the synthesis of doped cubic silicon carbide is performed targeting the production of anodes for application in high-performance lithium-ion batteries. The work focused on the reproducibility of the final materials composition and crystallinity. The work on establishment of structure property relationships and establishment of quality assurance program is still ongoing. The *InnovationCenter INM* has developed a continuous flow reactor to facilitate the initial sol-gel-reaction and a modular process for the following thermal processing up to 1000 °C. This intermediate product is further subjected to carbo-thermal treatment and final electrochemical characterization in the program division *Energy Materials*. For dry coating experiments at the industry partner site, currently several kilograms doped silicon carbide are produced by *InnovationCenter INM* at the larger lab-scale.

In a further industry project, novel nanoparticulate zinc oxide additives with intrinsic electronic defect structure have been successfully developed to enhance the dielectric strength of polymer composite-based electrical insulators. These are used in medium to high-voltage overhead and underground applications, such as ground-mounted electric power distribution transformers. The upscaling of the particle synthesis and the work-up process is planned for 2026 in order to transfer the project results into the production at the customer site.

OUTLOOK

InnovationCenter INM is participating in a joint DFG project (Patents4Science) together with the Leibniz institutes FIZ, INP and IWT on the topic “Building an information infrastructure for the use of patent knowledge in science”. INM’s application case in this project is on “Battery Materials” with the first phase involving the development of a seed entity list, annotation process using named entity recognition and planning of evaluation and test phase. As accompanying project for the work at *InnovationCenter INM*, the PSPC (Project support, Patents & Contracts) group initiated the project KITIE to identify and evaluate potential industry partners based on patent information.

In the upcoming years the technical infrastructure of the *InnovationCenter INM* will be renovated and adapted to the new research lines started at INM in the last years.

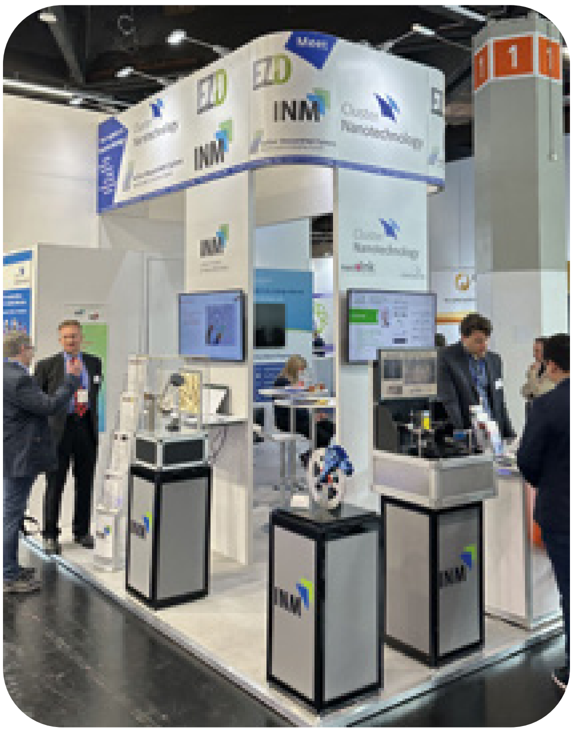


Fig. 1: Presentation of INM-technology on European Coatings Show 2025 in Nuremberg.
Fig. 2: Demonstration of sustainable inorganic binder fibreboard technology on nano tech 2025 fair in Tokyo.

Zentrale Einrichtungen / Core Facilities

Accelerated Research Foundry

Dr. Alvaro Banderas

Die Core Facility *Accelerated Research Foundry*, INMs zukünftiges Automatisierungslabor geht nunmehr nach Abschluß der Planungsphase in die Implementierung über. Für 2026 sind Tests und die Aufnahme des vollständigen Betriebs geplant. Die Anlage wird als modulares, vollständig integriertes System entwickelt, das von dynamischer Software gesteuert wird, wobei experimentelle Bewegungen von einem Roboterarm orchestriert werden, der entlang einer zentralen Schiene Instrumente und Arbeitsabläufe verknüpft. Wichtige Technologien umfassen einen akustischen Flüssigkeitsdosierer für die Dispensierung im Nanoliterbereich, einen Roboter zur Handhabung von Flüssigkeiten mit einem Beleuchtungsgerät für die Photovernetzung von Hydrogelen und die optogenetische Zellinduktion sowie Geräte für automatisiertes Klonieren und die Handhabung mikrobiologischer Kulturen. Zusammen ermöglichen diese Systeme fortschrittliche Lernzyklen bestehend aus Design-, Synthese-, Test- und Lernphase für eine beschleunigte Materialentwicklung.

Chemische Analytik / Chemical Analytics

Dr. Claudia Fink-Straube

Die Core Facility *Chemische Analytik* bietet analytische Dienstleistungen für alle Wissenschaftler des INM, der UdS sowie Externe an. Die analytische Begleitung und Unterstützung der Forschungsprojekte basiert auf gängigen Routinemessungen als auch Analysenoptimierungen bis hin zu Methodenentwicklung und -validierung und gelingt durch moderne Analyseverfahren der Elementanalytik (AAS, CHNOS, GFAAS, ICP-OES), Chromatographie (GC, HS/SPME-GC, HPLC, GPC/MALS) und Tandemverfahren mit Massenspektrometrie (GC/MS, LC-ESI HR-Q-TOF). Dies schließt Präparationsmethoden wie diverse Aufschluss- und Extraktionsverfahren via Mikrowelle, Hochdruck und SP(M)E ein. Regelmäßige Praktika zur Methodik chemisch-analytischer Messverfahren am INM werden für Studierende, Azubis und Schüler durchgeführt.

Elektronenmikroskopie / Electron microscopy

N. N.

Die Core Facility Elektronenmikroskopie ist für alle Mitarbeiterinnen und Mitarbeiter aus dem INM und dem universitären Umfeld Anlaufstelle bei elektronenmikroskopischen Fragestellungen. Die Proben können mit Hilfe eines Plunge-Freezers, einer Nanomill, eines Ultramikrotoms, eines Zweistahlgerätes (FIB) und verschiedener Sputter- bzw. Metallbeschichtungsanlagen sowie Schleif- und Einbettapparaturen in vielfältiger Weise vorbereitet werden. Als Untersuchungsmethoden stehen die Rasterelektronen- und Transmissionselektronenmikroskopie zur Verfügung, die Einblicke in Materialaufbau und -zusammensetzung von flüssigen und festen Proben bis in den Nanometerbereich ermöglichen.

Fluoreszenzmikroskopie / Fluorescence Microscopy

Dr. Cao Nguyen Duong

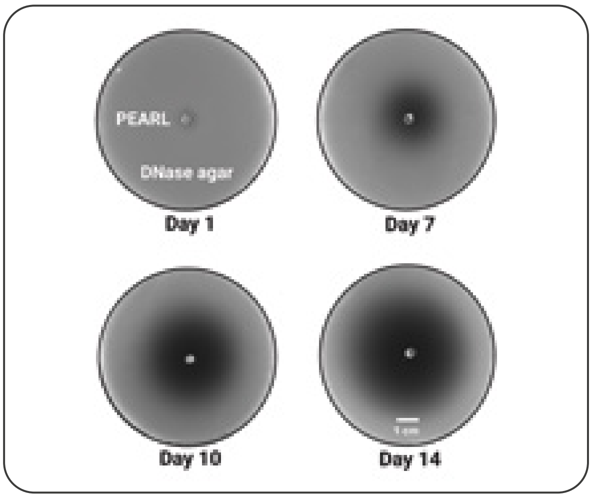
Die Core Facility *Fluoreszenzmikroskopie* unterstützt Forscher am INM und externe Nutzer mit modernsten Bildgebungsverfahren (Weitfeld, Total Internal Reflection Fluorescence (TIRF), Laser Scanning Confocal, Zwei-Photonen, Lightsheet, Hochdurchsatz-Bildgebung, Photomanipulation und Photostrukturierung). Wir begleiten die Nutzer während des gesamten Prozesses der mikroskopischen Bildgebung einschließlich der Planung, Probenvorbereitung, Auswahl und Einsatz des Mikroskopes, Bildverarbeitung, Bildanalyse und Visualisierung, sowie dem Datenmanagement. Darüber hinaus veranstalten wir einen Fluoreszenzmikroskopie-Kurs und organisieren Workshops zur Bildanalyse, um Nutzern zu helfen, sich mit den theoretischen Grundlagen vertraut zu machen und die sachgemäß, eigenständige Nutzung komplizierter Mikroskope und mikroskopischer Anwendungen zu erlernen.

02| Highlights

Material encapsulation enhances genetically programmed functions in lactobacilli

Varun Sai Tadimarri, Marc Blanch Asensio, Shrikrishnan Sankaran

Bioprogrammable Materials



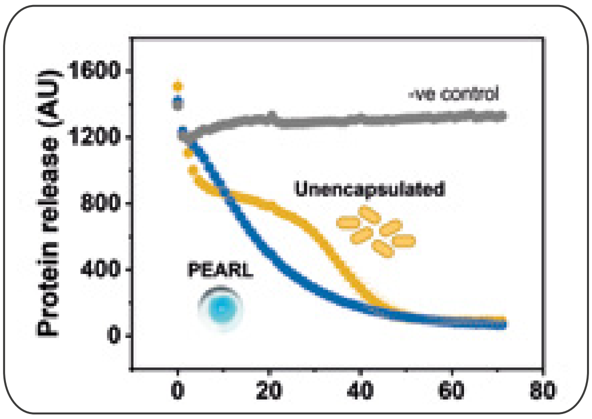


Fig. 1: Protein secretion from PEARLs visualized by dark halo on DNase agar plate for 14 days.

Fig. 2: Encapsulation stabilizes protein release from PEARLs compared to unencapsulated bacteria

Engineered living materials (ELMs) made of bacteria in hydrogels have shown considerable promise for therapeutic applications through controlled and sustained release of complex biopharmaceuticals at low costs and with reduced wastage. While most therapeutic ELMs use *E. coli* due to its large genetic toolbox, most live biotherapeutic bacteria in development are lactic acid bacteria due to the native health benefits they offer.

We embarked on developing therapeutic ELMs containing probiotic lactobacilli. In the study "PEARL: Protein Eluting Alginate with Recombinant Lactobacilli", we developed *L. plantarum*-based ELMs capable of sustained release of recombinant proteins. By combining novel genetic parts for recombinant protein secretion with alginate-based encapsulation, we achieved recombinant protein release for 14 days along with containment of the genetically modified bacteria. Furthermore, encapsulation stabilized the release profile of recombinant proteins, improved biocompatibility with human cells (cooperation with R6 Material-Host-Interactions), and eliminated toxicity towards zebrafish embryos compared to unencapsulated bacterial cultures (cooperation with HIPS).

Building on this platform, in the study "Encapsulation-enhanced switchable protein release from engineered probiotic lactobacilli", we equipped *L. plantarum* with genetic switches that regulate protein expression in response to food-grade small molecules. Here too, encapsulation greatly enhanced the performance of the genetic switches by reducing leaky expression seen in unencapsulated bacteria. This effect persisted in alginate beads of submillimeter size.

Thus, beyond expanding the genetic toolbox of *L. plantarum*, these studies demonstrated, a material-driven strategy to improve genetically engineered functions in lactobacilli.

V. S. Tadimarri, M. Blanch-Asensio, K. Deshpande, J. Baumann, C. Baumann, R. Müller, S. Trujillo, S. Sankaran
Small (2025) *22* (16), 2408316.
M. Blanch-Asensio, V. S. Tadimarri, R. Martinez, G. S. Dahiya, C. N. Duong, R. Lale, S. Sankaran
J Controll Release (2025) 387, 114264.

Discovering a Nanowire Gel: Formation Mechanism and Mechanical Properties

Yannic Curto, Srishti Arora, Bart-Jan Niebuur, Lola González-García, Tobias Kraus

Structure Formation, Electrofluids

Ultrathin metal nanowires with aspect ratios of up to 103 and conductive gold cores are used in sensor technology and electronics. Spherical nanoparticles are the basis of gels and aerogels with a porous 3D macroscopic structure with interest for catalysis and sensing.

We recently brought these two fields together: As we chemically induced the gelation of ultrathin gold nanowires, macroscopic 3D gel bodies formed (Figure 1). Freeze drying yielded highly porous aerogels with densities close to silica aerogels (Figure 2). We studied the structure of the gels and aerogels, their formation mechanism and their mechanical properties.

Gelation starts with the replacement of oleylamine (OAm) molecules on the surfaces of gold nanowires by triphenylphosphine (PPh3). The wires then slowly separate from the solvent because the interaction of PPh3 with the solvent is weaker than that of OAm. Electron microscopy and Small Angle X-Ray scattering indicated that the wires were originally arranged in long hexagonal bundles. Adding PPh3 to the nanowires dissolved these bundles; instead, the wires bent more and became increasingly entangled. Rheological measurements showed that this entanglement and concurrent physical cross-linking lent the gels stiffness and made them viscoelastic solids. We thus tuned their stiffness by adjusting the PPh3 concentration during the gelation.

Nanowire gels are intriguing because they resemble colloidal and polymer gels. Instead of long molecular chains that entangle, the new gels are made from metal wires. Our results show how their properties can be adjusted, and we are investigating applications of gold nanowire gels and aerogels in sensing and electronics.

Y. Curto, S. Arora, B.-J. Niebuur, L. González-García, T. Kraus, Small (2025), 21 (14), 2411506

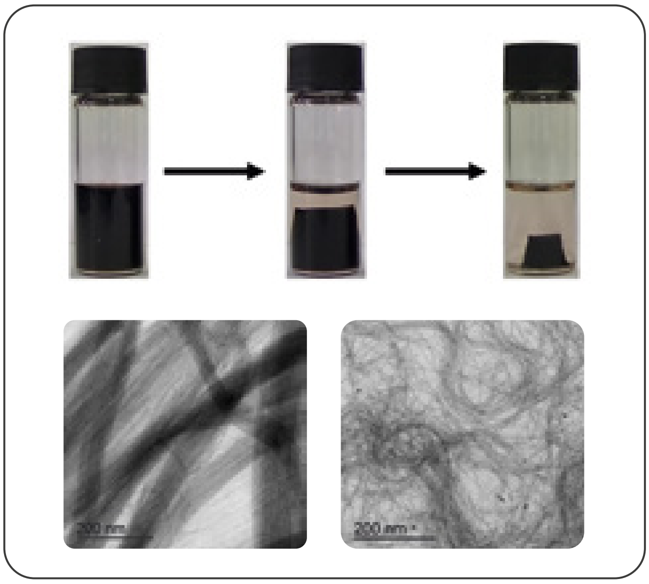
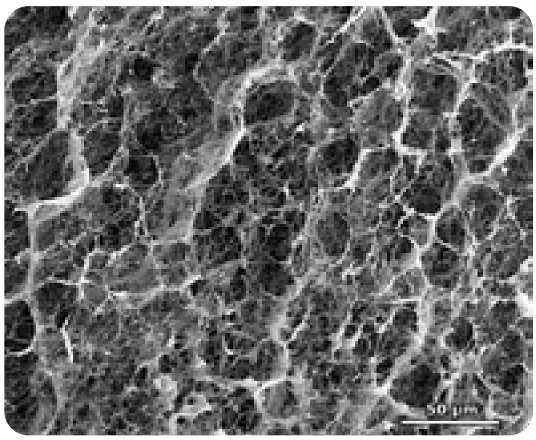


Fig. 1: a) Gold nanowire gel during gelation after 0 h, 2 h, and 9 h hours. b) Electron microscopy shows b) that the nanowires are in bundles before gelation that c) dissolve and are replaced by entangled “meshes” during gelation.

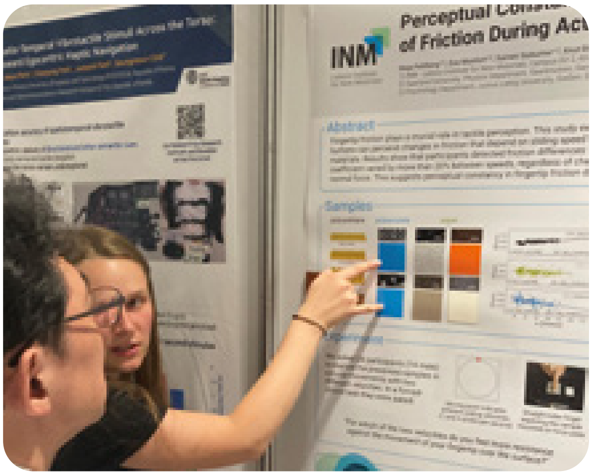
Fig. 2: Scanning electron microscopy image of the freeze-dried aerogel.



Haptics Research at INM

Roland Bennewitz

Interactive Surfaces



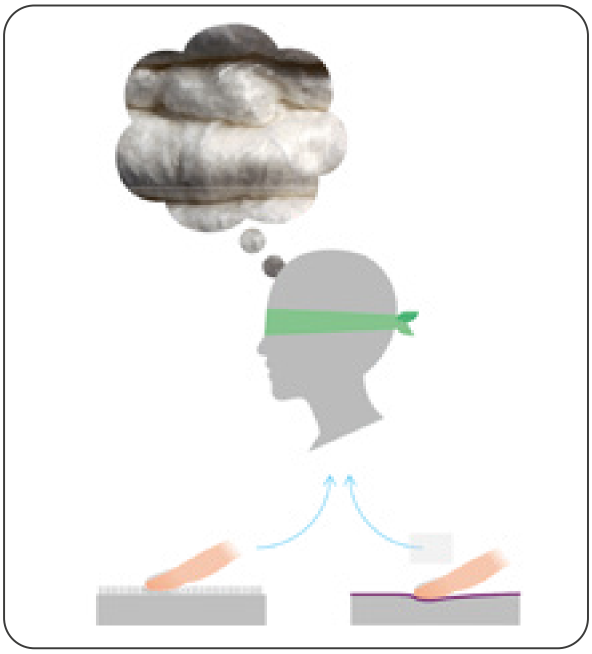


Fig. 1: Maja Fehlberg, PhD student at INM, explains her work at the World Haptics Conference in Seoul in June 2025.

Fig. 2: The idea of Surface Softness: How can we develop a polymer material that feels soft to the touch and evokes the sensation of raw silk in the brain?

Materials for the future of tactile communication – this has been the goal of haptics research in the Research Division *Interactive Surfaces* in the last years. The results have become internationally visible with our presentations at the World Haptics Conference in Seoul in June 2025. Doctoral student Sairam Saikumar presented his study on surface structures for a *Tactile White* in a very well-attended talk. His colleague Maja Fehlberg discussed her recent paper (Fig. 1) on perceptual constancy in friction perception. PostDoc Nedim Göktepe organized a workshop on *Haptic Materials from Physics to Perception*, while group leader Roland Bennewitz introduced the haptics community to the results of a large cooperative study on physiology and materials perception with our partners at Charité Hospital in Berlin.

Our progress in validating the tactile appeal of materials is greatly supported by the close cooperation with psychologist Prof. Knut Drewing in Gießen. A new joint project on the perception of *Surface Softness* (Fig. 2) will be supported over the next three years by DFG. The shared aim is to elucidate physical and psychological principles serving to understand perception and to improve the design of soft surfaces. At *INM*, materials with well-defined parameters are produced and their interaction with the probing fingertip is characterized. At Justus-Liebig University in Gießen, psychophysical experiments are performed with these materials, which can answer the question of the perceptual mechanisms for surface softness. Our results will shed light on the mechanisms that underlie the judgement of surfaces being hard and soft. We contribute to the understanding of well-being in our environment and lay a foundation for the design of polymer materials with surfaces that can make medical devices comfortable, invite the touch of social robots, or increase the acceptance of sustainable materials.

Energy-efficient manufacturing processes for optical interference multilayer systems on glass

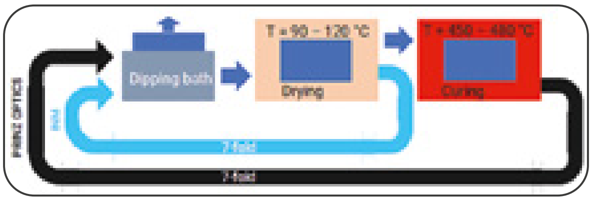
Kira Fries, Mohammad Jilavi, Sarah Schumacher, Bruno Schäfer
and Peter William de Oliveira

Optical Materials

The production of interference coating systems by physical or chemical vapor deposition is expensive and highly energy consuming. Even in sol-gel process, individual layers in a multilayer system require a single high-temperature curing step with high energy costs. In cooperation with an industrial partner, INM developed a new thermal stack curing process for the sol-gel manufacturing processes of multilayer interference filter systems. Here, each individual layer of a multilayer system is dried briefly. The stack is treated in a final step at high-temperature, leading to time and cost savings and being compatible with current production equipment.

By using high and low-refractive coating soles and a specified design for the interference filter, a critical limit for crack-free layer stacking at low temperatures was determined. With this finding, the number of layers required for crack-free stack curing can be calculated, resulting in a maximum number of layers per stack above which a high-temperature layer is absolutely necessary throughout the entire manufacturing process and how often this must be done. Taking into account critical temperature instability of the sols and at which higher temperature this can be optimized, further design options for the stack curing process arise. For example, by increasing temperature in drying of an unstable layer, the number of layers in stack can be increased, further reducing the total number of curing steps required in the manufacturing process.

With these results, our industry partner was able to integrate the new process in the production: They successfully manufactured 8-layers functional interference filters on A4-sized BF33 glass in a two-step stack curing process. With 480 °C curing, stack curing interference filters were transparent, crack-free and spectrally comparable to the conventional reference samples, thus. confirming the successful use of the innovative stack curing process. The industrial partner produced 5-layer optical series yellow filters in one-step stack curing. Here, the process delivered 63% lower energy consumption and 85% shorter process time compared to the conventional method. The ZIM project Stack Cure-Development of an energy-efficient manufacturing process to produce optical interference multilayer systems was funded by the BMWK.



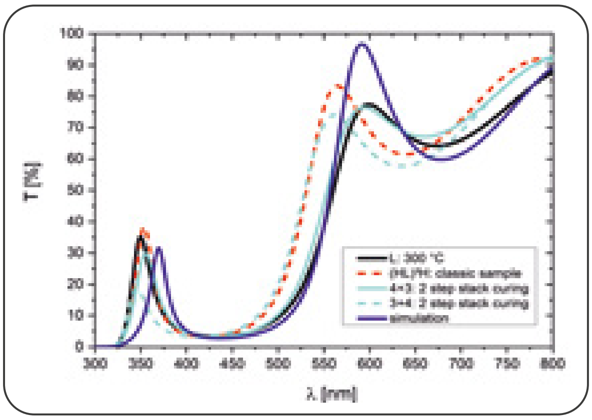


Fig. 1: Current (black) and new developed (cyan) process to produce optical interference layer systems on glass.
Fig. 2: Comparison of the UV-VIS spectra of 7-layer systems on Borofloat glass from different stack curing variants with a conventional reference sample and a numerical simulation (TFCalc).

Synthetic tumor immune microenvironments

Nils Piernitzki, Ning Gao, Gilles Gasparoni, Louisa M Krauß, Julia Schulze-Hentrich, Michael Dustin, Bianca Schrul, Balázs Győrffy, Stephen Mann, Oskar Staufer

Immuno-Materials

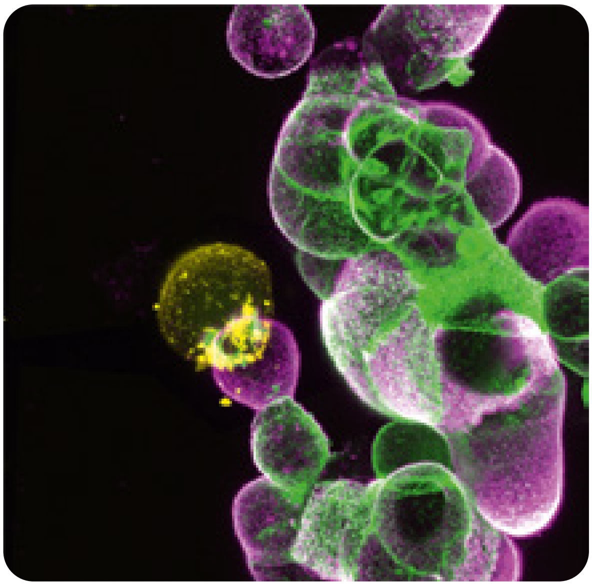


Fig. 1: Pancreatic cancer 3D culture composed of living and synthetic cells.

Tumors do not consist of cancer cells alone, but also contain a diverse range of immune cells. Their interactions shape how tumors evolve and how they respond to therapy. Yet, studying this tumor immune microenvironment (TIME) in the lab has remained difficult: while cancer cells readily grow in culture, immune cells are challenging to maintain over time, making long-term, controlled experiments hard to achieve.

To overcome this limitation, researchers from the Research Group Immuno Materials, together with international collaborators at the University of Oxford and the University of Bristol (UK), Semmelweis University (Hungary), and Saarland University, developed fully synthetic immune cells. These artificial immune cells are oil-droplet-based particles equipped with immune-like functions and precisely defined molecular compositions. In their Nature Communications publication, the team demonstrates that these synthetic immune cells can be co-cultured with human pancreatic cancer cells to form miniature 3D tumors. Unlike living immune cells, the synthetic counterparts remain stable in culture and do not die off, enabling sustained experiments under highly controlled conditions. This allowed the researchers to observe how cancer cells attempt to evade what appears to be a natural immune attack and to dissect the underlying mechanisms in detail. In particular, they uncovered an evasion strategy involving the immune checkpoint protein PD-1, a key target of several cancer immunotherapies.

This work opens new opportunities to study immune escape with unprecedented precision in vitro, while also representing an important step toward integrating living and synthetic systems, bringing biology-inspired materials closer to bridging living and non-living matter.

N. Piernitziki et al.
Nat Commun (2025) 16, 11073

Technology Transfer Day for Living Therapeutics

Shrikrishnan Sankaran, Hannah Jahn-Kelleter, Aranzazu del Campo

Bioprogrammable Materials, Dynamic Biomaterials

Engineered Living Therapeutics are reshaping the landscape of biomedical innovation. Engineered microbes can navigate to disease sites in the body, sense pathological signals, and produce therapeutics on demand – offering targeted, responsive, and potentially low cost treatments. Yet despite decades of research, no therapy has reached clinical approval. A bottleneck is the ability to translate scientific discoveries into safe, scalable, and regulated products.

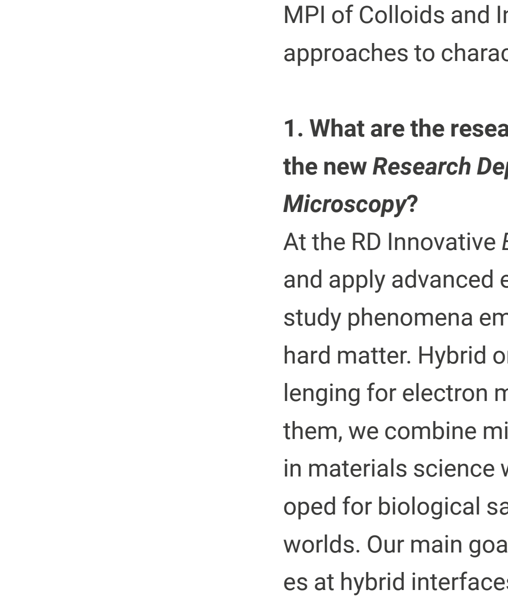
Under the umbrella of the Leibniz Science Campus *Living Therapeutic Materials*, INM organized a Tech-Transfer Day on November 19, bringing together innovators regulatory consultants, industrial experts, and LifeMat members to discuss pathways from laboratory breakthroughs to safe and useful therapeutic solutions. Key pioneers of the field, Lothar Steidler and Sabine Neirynck (Swartberg Experts), shared foundational insights from decades of work. Moderated round table sessions with Max G. Ostermeier (Implandata Ophthalmic) and Prof. Avi Schroeder (Israel Institute of Technology) focused on the practical hurdles of translation – regulation, GMP manufacturing, quality control, funding gaps, and market adaption. Participants discussed how industry evaluates new platforms and where collaborative development can accelerate readiness. The event concluded with a Lab Tour through INM for external participants. Together, these efforts underscore a central message: the future of LTMs depends not only on scientific breakthroughs, but on building bridges that carry them from research to societal impact.

Fig. 1 and 2: Impressions from the Technology Transfer Day for Living Therapeutics.

Focus on new people: Nadezda Tarakina

Since 09-2025 Nadezda Tarakina is Head of the *Research Department Innovative Electron Microscopy* at INM and Professor at Saarland University. She obtained her PhD in Chemistry from the Ural Branch of the Russian Academy of Sciences and habilitation in Experimental Physics from the University of Würzburg, Germany. Throughout her career she worked in various research centers in Belgium, UK, Germany and Sweden, applying advanced electron microscopy techniques to study structure-function relations in highly disordered materials. In the last 8 years she led the Electron Microscopy research group at MPI of Colloids and Interfaces, Potsdam, focussing on approaches to characterize hybrid and soft materials.

1. What are the research topics and perspectives for the new *Research Department Innovative Electron Microscopy*?
At the RD Innovative *Electron Microscopy*, we develop and apply advanced electron microscopy methods to study phenomena emerging at the interface of soft and hard matter. Hybrid organic-inorganic systems are challenging for electron microscopy; in order to characterize them, we combine microscopy approaches typically used in materials science with imaging methodologies developed for biological samples, taking the best from both worlds. Our main goal is to be able to follow the processes at hybrid interfaces on the atomic scale, to explain their functionalities and provide guidance for materials design.



2. How will INM research profit from your methods? Which cooperations do you foresee for the near future?
Nowadays an electron microscope represents a nanoscale analytical laboratory in one device, with which we can study crystal structure, electronic structure, chemical composition and morphology of various materials, and follow their transformations and reactions at the nanoscale. The ability to provide nanoscale views on various material systems and the specific focus of our department on the study of interfacial processes are in line with research topics of many research groups/departments at INM. Apart from developing innovative research methodologies, our department has a strong service unit, which supports users from across INM, on the Campus, and beyond INM. I envision tight cooperation with many research departments at INM.

3. Where do you see your *Research Department* in five years?
In five years, we will be grown and a vivid hub for nanoscale research at INM Campus SAAR and a recognized center for electron microscopy of hybrid systems in Germany. Still a lot has to be done to reach this goal but having a strong and enthusiastic team, the support of colleagues, and the extremely interesting and challenging topic of hybrid systems to work on makes me sure we will get there.

The Working Group Digitalization

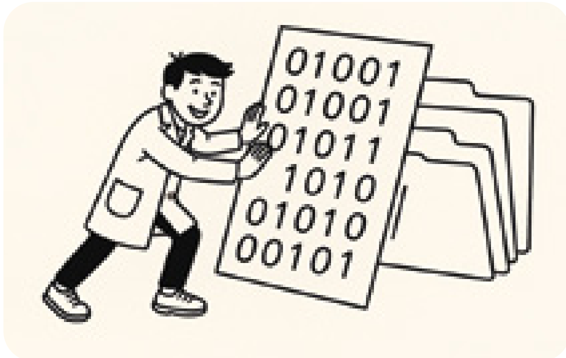
Soni Lama and Roland Bennewitz

SG RDM and Interactive Surfaces

The digital transformation of science offers new opportunities for literature research with knowledge graphs, experimental design and documentation, advanced data analysis including machine learning, and data-driven collaboration. The *Working Group Digitalization* at INM unites scientists and support staff who are interested in contributing to this transformation by acting as early adopters, discussing tools and procedures, and preparing in-house workshops. The WG Digitalization complements the structured effort in Research Data Management by our central service group Research Data Management.

A key element of digitalization at INM is the electronic laboratory notebook (ELN) *ResearchSpace*, which was rolled out at INM in 2024. Members of the *Working Group Digitalization* have helped this implementation by sharing their experience with an increasing number of fellow scientists and have developed training of every day relevance. For example, a standardized template for standard operating procedures in a large cooperative project has promoted uniform documentation practices and enabled efficient tracking of experiments and associated data. One research group has connected INM´s inventory system with our ELN and enabled centralized access to inventory information and direct linking of laboratory items with their associated experimental documentation. The database of all chemicals stored at INM with related safety information is also linked to the electronic notebook.

In the year 2025, the Service Group Research Data Management focused on a structuring element in digital science practice, namely the *Data Management Plan* to be established at the beginning of all scientific projects. An electronic template for these plans is now available Training on how to write an own data management plan was provided during a hands-on workshop held by our Data Steward Soni Lama. We look forward to structured metadata, a focus of our work in 2026. And we will enjoy more heated discussions on our multi-facetted approach to AI in science.



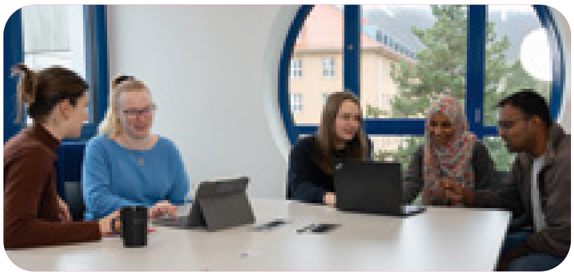


Fig. 1: Logo for an exciting transformation of science in time of new digital tools and opportunities.
Fig. 2: INM scientists collaborating on the development of a data management plan during an in-house workshop.

INM fellow explores transcriptional and epigenetic dynamics in living materials

Julia Schulze-Hentrich

Since 2023, Julia Schulze-Hentrich has been Professor of Genetics and Epigenetics at Saarland University in Saarbrücken, where her research group investigates the role of genomic and epigenomic regulation in various health and disease contexts, with a particular focus on neurodegenerative disorders and sex-specific aspects.

After studying biology at the Universities of Göttingen and Jena, Julia pursued her PhD in Genetics at the University of British Columbia in Vancouver, Canada. Subsequently, she held postdoctoral and group leader positions at the University of Tübingen before joining Saarland University. Julia fosters several interdisciplinary and international collaborations, most recently the coordination of the Priority Programme of the German Research Foundation on molecular mechanisms underlying sex differences in neuroglial cell function. Her work on epigenetic regulation combines experimental and computational approaches to better understand health and disease, often in relation to ageing and sex-specific particularities. The overarching goal of her research is to map and link functional changes in gene activity with epigenetic modalities from cell models to human.

To achieve this, the Schulze-Hentrich group employs and develops cutting-edge molecular techniques and analysis pipelines, generating large-scale molecular data sets in the EpiGenomics Facility at Saarland University. The infrastructure includes sequencers that allow interrogating the multi-omics landscape at single-cell resolution. By leveraging short- and long-read technologies from Illumina, Element Biosciences, and Oxford Nanopore Technology, her team selects the most appropriate sequencing strategy for each research projects in a cost-effective, high-quality manner.

In 2025, Julia Schulze-Hentrich was appointed INM Fellow to advance research on transcriptional and epigenetic dynamics in living materials. In ongoing cooperations, her work investigates the adaptive capabilities of such engineered cells under dynamic environmental conditions, where the epigenome serves as a pivotal regulatory interface between genome and environment.

INM Research on Electrochemical Lithium Recovery Aboard the motor ship MS Wissenschaft

Stefanie Arnold and Volker Presser

Energy Materials

In the Science Year 2025, Energy of the Future, the MS Wissenschaft toured through Germany and Austria, bringing current energy research directly to the public. On board the 102-meter long former cargo vessel, 55,000 visitors explored an interactive exhibition on hydrogen, batteries, and sustainable resource management.
One of the exhibits was contributed by INM - Leibniz Institute for New Materials and presented work from the INM Research Department Energy Materials on sustainable lithium recovery. As lithium-ion batteries are key to electric mobility and renewable energy storage, resource-efficient and circular lithium supply routes are becoming increasingly important, including recovery from aqueous resources and from recycling streams.

The exhibit showcased an electrochemical approach to selectively capture lithium ions from saline waters such as seawater, mine water, and geothermal brines, without chemical additives and with low energy demand. The same principle is applicable to lithium recovery from spent batteries. A 3D animated visualization of the electrochemical cell formed the centerpiece, complemented by illustrated panels that placed the technology in context, from global lithium resources to comparable aqueous reservoirs in Germany. This helped visitors better understand the challenge and realistic solution pathway.

At tour stops in Duisburg and Saarbrücken, Volker Presser and Stefanie Arnold joined “Meet the Scientist” sessions and discussed battery myths, lithium recycling, and future energy technologies. In Saarbrücken, the exhibit also welcomed Jakob von Weizsäcker, Saarland’s Minister of Finance and Science.
The MS Wissenschaft stopovers showed how materials research can move beyond the lab into direct dialogue with society, encouraging curiosity and informed discussion on the energy transition.

Fig. 1: Visitors of all ages gathered information on sustainable lithium extraction at the INM stand.
Fig. 2: Saarland’s Minister of Finance and Science, Jakob von Weizsäcker (left), showed great enthusiasm for the battery research being conducted at INM.

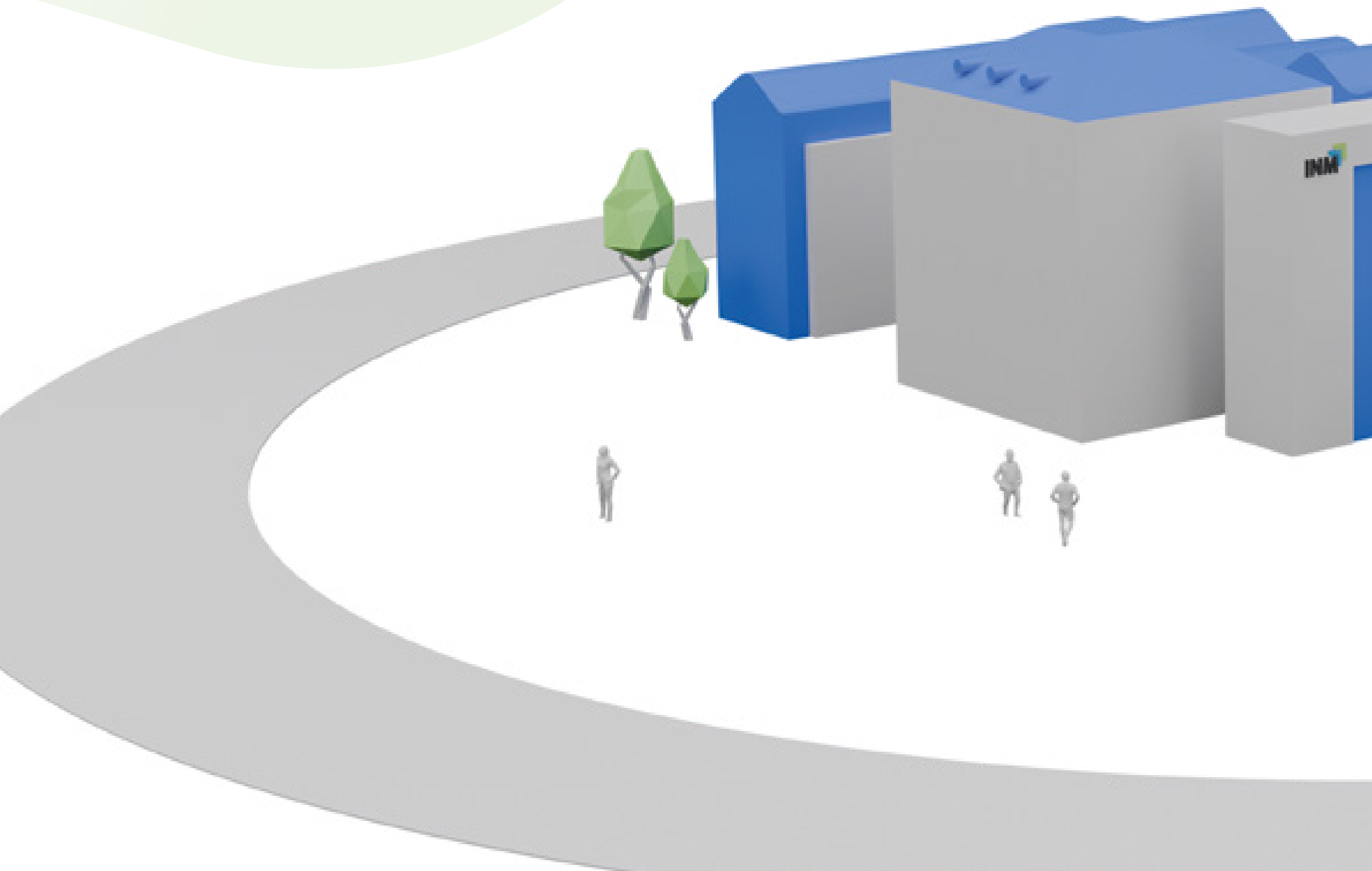
03|

Fakten & Zahlen / Facts & figures 2025

256
employees from
40 countries (49 % female)

128
scientists (46 % female)
thereof: **51** doctoral researchers

34
events



30.62
million € total turnover
7.03 million € third party funding

112
publications in total
90 thereof in peer-reviewed publications

52
invited talks
155 other talks

3
patent applications
4 granted patents

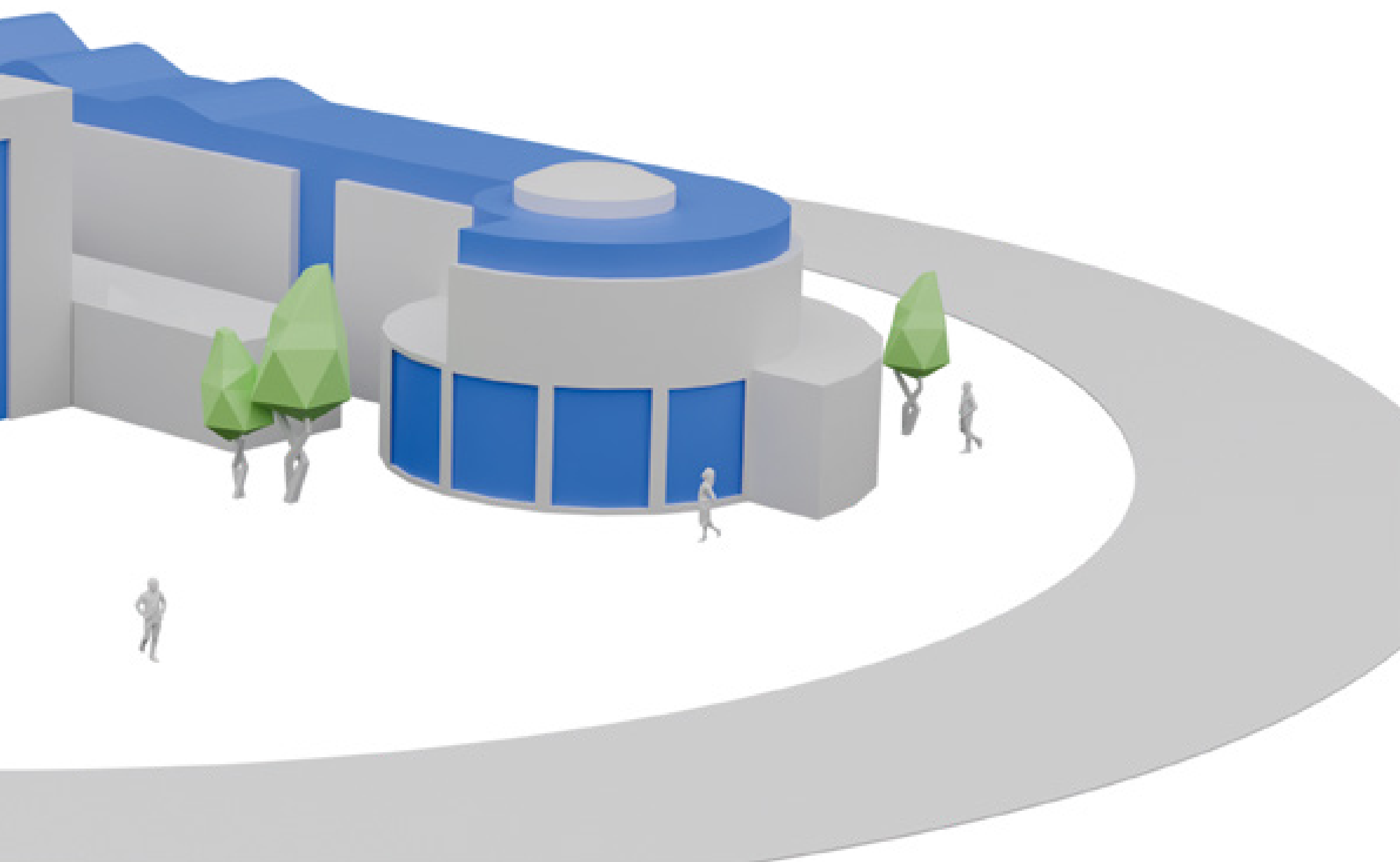
57
cooperation projects and **7** joint professors with Saarland University

55
international cooperations with institutions from **22** countries

45
cooperations with 45 institutions in Germany

44.4
weekly teaching hours per year

11
doctoral theses
12 master theses
4 bachelor theses



Ausgewählte Publikationen / Selected Publications

M. Blanch-Asensio, V. S. Tadimarri, R. Martinez, G. Singh Dahiya, C. N. Duong, R. Lale and S. Sankaran
Encapsulation-enhanced switchable protein release from engineered probiotic lactobacilli
Journal of Controlled Release, 2025, 387, 114264
doi:10.1016/j.jconrel.2025.114264

Z. Kafrashian, S. Brück, P. Rogin, H. S. U. B. Farrukh, S. Pearson and A. Del Campo
Segmented, Side-Emitting Hydrogel Optical Fibers for Multimaterial Extrusion Printing
Advanced Materials, 2025, 37, (4), 2309166
doi:10.1002/adma.202309166

K. K. Desai, S. Sankaran, A. Del Campo and S. Trujillo
A screening setup to streamline in vitro engineered living material cultures with the host
Materials Today Bio, 2025, 30, 101437
doi:10.1016/j.mtbio.2024.101437

D. Roy, V. B, S. Mandal, A. Gupta, S. Benedikt, S. Koyiloth Vayalil and T. Kraus
Origin of Dynamic Network Formation of 2D Nanofillers in a Flexible Matrix
Small structures, 2025, 6, (8), 2400608
doi:10.1002/sstr.202400608

E. Pameté, J. G. de Andrade Ruthes, M. Hermesdorf, A. Seltmann, D. J. Tarimo, D. Leistenschneider and V. Presser
Dry Electrode Processing for Free-Standing Supercapacitor Electrodes with Longer Life, Higher Volumetric Outputs, and Reduced Environmental Impact
Energy & Environmental Materials, 2025, 8, e12775
doi:10.1002/eem2.12775

N. Piernitzki, N. Gao, G. Gasparoni, L. M. Krauß, J. Schulze-Hentrisch, M. Dustin, B. Schrul, B. Györffy, S. Mann and O. Staufer
Self-assembly of hybrid 3D cultures by integrating living and synthetic cells
Nature Communications, 2025, 16, 11073
doi:10.1038/s41467-025-66789-3

D. Perius, M. Engstler, S. Blum, L. González-García and T. Kraus
Reconstruction of 3D Conductive Networks in Metal-Filled Elastomer Composites Indicates Dominance of Contact Resistances
Small Structures, 2025, 6, (10), 2500234
doi:10.1002/sstr.202500234

H. Mohsenin, R. Schmachtenberg, S. Kemmer, H. J. Wagner, M. Johnston, S. Madlener, C. Dincer, J. Timmer and W. Weber
Signal-Amplifying Biohybrid Material Circuits for CRISPR/Cas-Based Single-Stranded RNA Detection
Advanced Materials Technologies, 2025, 10, (2), 2400981

Y. Curto, S. Arora, B.-J. Niebuur, L. González-García and T. Kraus
Hybrid Ultrathin Gold Nanowire Gels: Formation and Mechanical Properties
Small, 2025, 21, (14), 2411506
doi:10.1002/smll.202411506

Das INM in Zahlen / INM in Figures

Stand / As of: 03.03.2026

Im Jahr 2025 betrug der **Gesamtumsatz** des INM **30,62 Mio. €**.

Erlöse aus der gemeinsamen Finanzierung durch den Bund und die Länder (**institutionelle Förderung**): **23,43 Mio. €**,

- davon Personal- und Sachaufwendungen: **16,73 Mio. €**
- und für Investitionen: **6,70 Mio. €.**

Erlöse aus Drittmittelvorhaben: 7,03 Mio. €

- davon **5,14 Mio. €** aus Förderungen für die Grundlagenforschung und anwendungsbezogene Forschung
- und **1,89 Mio. €** aus Förderungen mit Industriekooperationen.

Sonstige betriebliche Erträge: **0,16 Mio. €**

Das INM hatte Ende 2025 **256 Beschäftigte** (**130 m, 125 w, 1 d**), davon

- **77** Wissenschaftler/innen (**45 m, 31 w, 1 d**),
- **51** Promovierende (**23 m, 28 w**),
- **50** Beschäftigte (**26 m, 24 w**) in den Bereichen Labor, Technik und Service,
- **35** Beschäftigte (**12 m, 23 w**) in der Verwaltung und den Sekretariaten,
- **37** Hiwis (**20 m, 17 w**) und **6** Auszubildende (**4 m, 2 w**).

In 2025, the total turnover of INM added up to **30.62 million €**.

Proceeds from the joint financial support by the federal government and the federal states (**institutional funding**): **23.43 million €**,

- including expenses for personnel and materials: **16.73 million €**
- and for investments: **6.70 million €.**

Proceeds from third party funding: 7.03 million €

- including **5.14 million €** from funding for basic and applied research
- and **1.89 million €** from funding within the framework of industrial cooperations.

Other operating income: **0.16 million €**.

At the end of 2025, **256 employees** (**130 m, 125 f, 1 d**) worked at INM including:

- **77** scientists (**45 m, 31 f, 1 d**),
- **51** doctoral researchers (**23 m, 28 f**),
- **50** employees (**26 m, 24 f**) in laboratories and technical services,
- **35** employees (**12 m, 23 f**) in administration and secretarial offices,
- **37** graduate assistants (**20 m, 17 f**) and **6** apprentices (**4 m, 2 f**).

m = männlich, w = weiblich, d = divers / m = male, f = female, d = diverse

Kuratorium & Wissenschaftlicher Beirat / Board of Trustees & Scientific Advisory Board

Mitglieder des Kuratoriums / Members of the Board of Trustees

Stand / As of: 31.12.2025

Mitglieder des Wissenschaftlichen Beirats / Members of the Scientific Advisory Board

Stand / As of: 31.12.2024

Dissertationen / Doctoral Theses

Indra Backes
Conductivity, structure and bioconjugation of gold-polythiophene hybrid nanoparticles for printed electronics
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Selim Basaran
Thermoplasmonic stimulation of gold nanorods for engineered living materials
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Lukas Engel
Morphology, Performance, and Stability of Flexible and Transparent Electrodes Imprinted from Gold Nanowires and -spheres
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Amir Haghipour
Electrode Engineering of Metal-Oxide-Based Materials for Optimized Lithium-Ion Batteries
Universität des Saarlandes
Prof. Dr. Volker Presser

David van Impelen
Low-temperature sintering of metal-based pastes for sustainable printed electronics
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Zahra Kafrashian
Hydrogel-based side-emitting optical waveguides for light and heat delivery
Universität des Saarlandes
Prof. Dr. Aranzazu del Campo

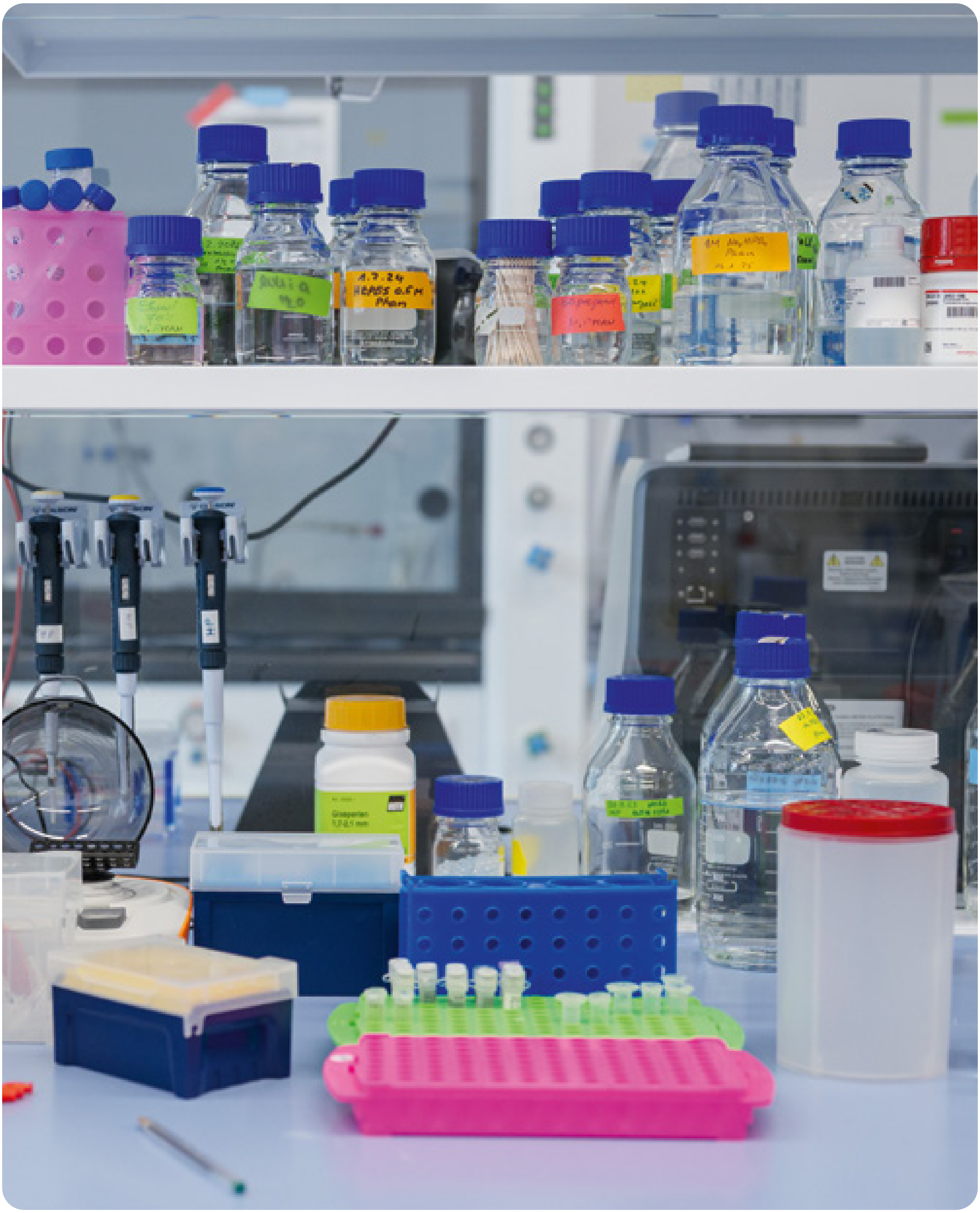
Enkeleda Meziu
Nanoparticle Interaction with mucosal barriers
Universität des Saarlandes
Prof. Dr. Marc Schneider, PD Dr. Annette Kraegeloh

Katharina Ostmann
Engineering of Synthetic Biological Sensors for Cell-Material Interfaces, the Presence of Aldehydes and for an Educational Kit
Universität Freiburg
Prof. Dr. Wilfried Weber

Andrea Pyttlik
Agglomeration of gold nanoparticles in microgravity
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Panyu Ren
Electrochemical Water Desalination for Ion Separation toward Ion-Selectivity and Sustainable Materials
Universität des Saarlandes
Prof. Dr. Volker Presser

Kordula Schellnhuber
Adhäsion und Reibung einzelner DNA-Moleküle
Universität des Saarlandes
Prof. Dr. Roland Bennewitz



Abschlussarbeiten / Theses

Bachelorarbeiten / Bachelor Theses

Andreas Geberle
Gold and Silver Alloy-Based Nanoparticles to Improve Mercury Detection in Sensors
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Elieser Hofmann
Self-regulation printed heaters from silver and carbon based inks
Hochschule für Technik, Wirtschaft und Kultur Leipzig
Prof. Dr. Tobias Kraus

Jonas Linke
Tribologie von Hydrogelen
Universität des Saarlandes
Prof. Dr. Roland Bennewitz

Lane Niga Magid
Shape stability of ultrathin nanowires with different core materials
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Masterarbeiten / Master Theses

Ahmed Aldubai
Stimuli-responsive genetic circuit in Corynebacterium glutamicum
Universität des Saarlandes
Prof. Dr. Aranzazu del Campo, Dr Shrikrishnan Sankaran

Minh Quan Bui
Fabrication of Nanoparticulate Constantan Ink for Inkjet Printing in Additive Manufacturing
Universität des Saarland
Jun.-Prof. Dr. Lola Gonzalez-Garcia / Prof. Carlo Holly (RWTH Aachen)

Wyatt Highland
Microfibrillated cellulose as a simple and sustainable binder for sodium-ion batteries
Universität des Saarland
Prof. Dr. Volker Presser

Elisabeth Hilgenfeld
Temperature-Controlled Hetero-Agglomeration of Plasmonic and Upconverting Nanoparticles for Tuneabie Luminescence
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Aleyna Ilezdi
Crack Analysis in Conductive Polymer Composites Using In-Situ Scanning Electron Microscopy
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Kim Michele Jost
Audio Feedback in Psychophysical Experiments on Haptic Perception
Universität des Saarlandes
Prof. Dr. Roland Bennewitz

Tamara Nink
T-Cell Migration Analysis within Lymphatic Bottom-Up Tissue for Adaptive-T-Cell-Therapy
Philipps-University Marburg
Dr. Oskar Staufer

Kadire Dicle Özcelik
Taktile Reibung in Experiment und Didaktik
Universität des Saarlands
Prof. Dr. Roland Bennewitz

Yesica Florez-Villabona
Artificial Tumor-Immune Microenvironment for mTNF Analysis in Cancer Cells
Universität des Saarlandes
Dr. Oskar Staufer

Niklas Walter
Synthetic Cell Systems for Ex-vivo Expansion of Human T-Cells
Karlsruhe Institut für Technologie
Dr. Oskar Staufer

Wenxin Yang
Protective Coating Engineered for Optical Hg Sensor: Aging Resistance and Mechanical Robustness
Universität des Saarlandes
Prof. Dr. Tobias Kraus

Zirui Ye
Construction of a Therapeutic Engineered Living Material with Thermo-responsive Pro-angiogenic Effects
Universität des Saarlandes
Prof. Dr. Aranzazu del Campo, Dr Shrikrishnan Sankaran

Auszeichungen / Awards

Stefanie Arnold, Peter Burger, Anna Seltmann
3rd place at the 5th International Olympiad in
Electrochemical Materials Science


CERTIFICATE
OF ACHIEVEMENT
This certificate is proudly presented to team:
Energetic people
from INM Leibniz Institute for New Materials, Germany
represented by:
Anna Seltmann, Peter Burger,
Stefanie Arnold
In recognition of securing 3rd Place at the 5th
International Olympiad in
Electrochemical Materials Science
19 November, 2025

Anna Burgstaller
74th Lindau Nobel Laureate Meeting
Council for the Lindau Nobel Laureate Meetings
Lindau, 29.06. – 04.07.2025

Anwesha Chatterjee
Conference participation grant
By: Leibniz Health Technologies
To attend: 24th Annual Conference of the European
Society of Biomaterials
Torino, Italy, 07. – 11.09, 2025

Mingren Liu
74th Lindau Nobel Laureate Meeting
Council for the Lindau Nobel Laureate Meetings
Lindau, 29.06. – 04.07.2025

Christian Müller
Dr. Eduard Martin-Preis der Universität des Saarlandes

Nils Pernitzki
Posterpreis auf der FEBS Conference 2025
Istanbul, Turkey, 05. – 09.07.2025

Victoria Pinto
Conference participation grant
By: Leibniz Health Technologies
To attend: NextGen Materials 2025
Hamburg, 23. – 25.09, 2025

Volker Presser
Highly Cited Researchers 2025
Clarivate

Rosanne Schmachtenberg
2. Posterpreis auf der NextGen Materials 2025
Hybrid conference
Deutsche Gesellschaft für Materialkunde, DGM
Hamburg, Germany, 23. – 25.09.2025

Oskar Staufer
Fellow in der Max Planck School „Matter to Life"
Max-Planck-Gesellschaft zur Förderung der
Wissenschaften e. V.

Oskar Staufer
Alois-Lauer-Forschungspreis für Medizin
Alois-Lauer-Stiftung
Dillingen, 16.12.2025

Varun Tadimarri
Poster Award
Gordon Research Conference
Lactic Acid Bacteria Biology, Symbioses and Applications
Ventura, CA, USA, 13. – 18.07.2025

Lara Luana Teruel Enrico
First Price for the Pitch
SynBioReactor Summit 2025
German Association for Synthetic Biology
Berlin, 17.02.2025

Delvina Japhet Tarimo
74th Lindau Nobel Laureate Meeting
Council for the Lindau Nobel Laureate Meetings
Lindau, 29.06. – 04.07.2025

Wensen Wang
Humboldt Research Fellowship for Experienced Researchers
Alexander-von-Humboldt Foundation

Wilfried Weber
JMR Distinguished Invited Speaker
MRS Fall 2026 Meeting
Boston, MA, USA, 30.11. – 05.12.2025

Wilfried Weber
Best Flash Presentation Awards
ACS Fall 2025 Digital Meeting – Biomaterial Strategies for Advanced Drug Delivery and Regenerative Medicine
Hybrid conference
Washington, DC, USA, 17. – 21.08.2025

Referierte Publikationen / Peer-reviewed Publications

Stand / As of: 20.03.2026

112

Publikationen / publications

davon / including

90

Publikationen in referierten Zeitschriften / publications in peer-reviewed journals

22

sonstige Publikationen / other publications

90

Publikationen im Open Access veröffentlicht / publications published in Open Access

davon / including

76

Beiträge in referierten Zeitschriften / contributions in peer-reviewed journals

Bioprogrammierbare Materialien / Bioprogrammable Materials

M. Blanch-Asensio, V. S. Tadimarri, R. Martinez, G. Singh Dahiya, C. N. Duong, R. Lale and S. Sankaran
Encapsulation-enhanced switchable protein release from engineered probiotic lactobacilli
Journal of Controlled Release, 2025, 387, 114264
doi:10.1016/j.jconrel.2025.114264

K. K. Desai, S. Sankaran, A. Del Campo and S. Trujillo
A screening setup to streamline in vitro engineered living material cultures with the host
Materials Today Bio, 2025, 30, 101437
doi:10.1016/j.mtbio.2024.101437

K. Deshpande, V. S. Tadimarri, J. Ramirez-Rangel, S. Sankaran and S. Trujillo
Developing an In Vitro Model of Endotoxemia to Assess the Immunomodulatory Effects of Anti-Inflammatory Peptide-Secreting Living Therapeutics
ACS Pharmacology & Translational Science, 2025, 8, (7), 2180-2191
doi:10.1021/acsptsci.5c00216

A. Khazem, R. Schmachtenberg, A. Weiand, S. Sankaran and W. Weber
Engineered microbial living matter for diagnostics, prevention, and therapy
Current Opinion in Biotechnology, 2025, 92, 103269
doi:10.1016/j.copbio.2025.103269

V. S. Tadimarri, T. A. Tyagi, C. N. Duong, S. Rasheed, R. Müller and S. Sankaran
Adaptations of Gram-Negative and Gram-Positive Probiotic Bacteria in Engineered Living Materials
ACS Biomaterials Science & Engineering, 2025, 11, (6), 3773-3784
doi:10.1021/acsbiomaterials.5c00325

Dynamische Biomaterialien / Dynamic Biomaterials

K. K. Desai, S. Sankaran, A. Del Campo and S. Trujillo
A screening setup to streamline in vitro engineered living material cultures with the host
Materials Today Bio, 2025, 30, 101437
doi:10.1016/j.mtbio.2024.101437

M. A. Fernández-Yagüe, E. N. Marquez, C. S. Poojari, J. Fu, Y. Wang, A. Del Campo and A. J. García
Mechanochemical waves in focal adhesions during cell migration
Science Advances, 2025, 11, eadw6425
doi:10.1126/sciadv.adw6425

J. González-Martín, A. del Campo, R. Muñoz and R. Lebrero
Optimizing the composition of bioactive coatings to support toluene removal
Journal of Environmental Chemical Engineering, 2025, 13, (4), 117324
doi:10.1016/j.jece.2025.117324

Z. Kafrashian, S. Brück, P. Rogin, H. S. U. B. Farrukh, S. Pearson and A. Del Campo
Segmented, Side-Emitting Hydrogel Optical Fibers for Multimaterial Extrusion Printing
Advanced Materials, 2025, 37, (4), 2309166
doi:10.1002/adma.202309166

M. Kohlstedt, F. Weiland, S. Pearson, D. Hero, S. Mihalyi, L. Kramps, G. Gübitz, M. Gallei, A. Del Campo and C. Wittmann
Biological upcycling of polystyrene into ready-to-use plastic monomers and plastics using metabolically engineered Pseudomonas putida
Chemical Engineering Journal, 2025, 524, 168431
doi:10.1016/j.cej.2025.168431

J. A. Mekontso Ngaffo, U. Farrukh, S. Trujillo and A. Del Campo
A practical workflow for cytocompatibility assessment of living therapeutic materials
Biomaterials Advances, 2025, 169, 214182
doi:10.1016/j.bioadv.2025.214182

T. Steudter, T. Lam, H. Pirmahboub, C. Stoppel, L. Kloke, S. Pearson and A. Del Campo
A Comparative Study between Thiol-Ene and Acrylate Photocrosslinkable Hyaluronic Acid Hydrogel Inks for Digital Light Processing
Macromolecular Bioscience, 2025, 25, (3), 2400535
doi:10.1002/mabi.202400535

Elektrofluide / Electrofluids

Y. Curto, S. Arora, B.-J. Niebuur, L. González-García and T. Kraus
Hybrid Ultrathin Gold Nanowire Gels: Formation and Mechanical Properties
Small, 2025, 21, (14), 2411506
doi:10.1002/smll.202411506

A. Haghipour, S. Arnold, J. Oehm, D. S. Schmidt, L. Gonzalez-Garcia, H. Nakamura, T. Kraus, V. Knoblauch and V. Presser
Optimized Preparation and Potential Range for Spinel Lithium Titanate Anode for High-Rate Performance Lithium-Ion Batteries
Advanced Energy and Sustainability Research, 2025, 6, 2400239
doi:10.1002/aesr.202400239

N. Hautz and L. González-García
Direct Ink Writing of Carbon-Based Electrofluids for Soft Electrical Component Manufacturing
Advanced Materials Technologies, 2025, 10, (16), e02012
doi:10.1002/admt.202402012

S. Lago-Garrido, D. S. Schmidt, M. J. Martin Alfonso and L. González-García
Multi-Walled Carbon Nanotubes Suspensions as Liquid Conductors: Electrical and Mechanical Network Interplay
Advanced Engineering Materials, 2025, 11, (11), 2400917
doi:10.1002/aelm.202400917

D. Perius, M. Engstler, S. Blum, L. González-García and T. Kraus
Reconstruction of 3D Conductive Networks in Metal-Filled Elastomer Composites Indicates Dominance of Contact Resistances
Small Structures, 2025, 6, (10), 2500234
doi:10.1002/sstr.202500234

D. Van Impelen, L. González-García and T. Kraus
Recyclability-by-design of Printed Electronics by Low-Temperature Sintering of Silver Microparticles
Advanced Electronic Materials, 2025, 11, (4), 2400533
doi:10.1002/aelm.202400533

D. Van Impelen, D. Perius, L. González-García and T. Kraus
The importance of shape: flakes and spheres in recyclable conductive pastes for printed electronics
RSC Sustainability, 2025, 3, (4), 1800-1806
doi:10.1039/D4SU00721B

Energie-Materalien / Energy Materials

S. Arnold and V. Presser
Competing ion effects and electrolyte optimization for electrochemical lithium extraction from spent lithium iron phosphate battery cathodes
Energy Advances, 2025, 4, (9), 1114-1129
doi:10.1039/D5YA00172B

S. Arnold, L. Wang, R. Mertens, S. Wieczorek and V. Presser
Optimized electrochemical recovery of lithium-ions from spent battery cells using carbon-coated lithium iron phosphate
Separation and Purification Technology, 2025, 367, 132770
doi:10.1016/j.seppur.2025.132770

A. Haghipour, S. Arnold, J. Oehm, D. S. Schmidt, L. Gonzalez-Garcia, H. Nakamura, T. Kraus, V. Knoblauch and V. Presser
Optimized Preparation and Potential Range for Spinel Lithium Titanate Anode for High-Rate Performance Lithium-Ion Batteries
Advanced Energy and Sustainability Research, 2025, 6, 2400239
doi:10.1002/aesr.202400239

J. Kim, L. Siegwardt, R. Leiner, S. Verwaayen, A. Novak, M. Schneider, V. Presser and M. Gallei
pH- and Anion-Responsive Poly(1-vinylimidazole) Opal Films for Smart Sensing
ACS Applied Polymer Materials, 2025, 7, (3), 1955-1968
doi:10.1021/acsapm.4c03736

C. Kök, P. V. Hernández, J. G. A. Ruthes, O. Janka, A. Quade and V. Presser
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Strukturbildung / Structure Formation

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Nicht an wissenschaftliche Einheiten gebunden / Not linked to scientific units

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Designing Smartly: Understanding the Crystallinity of Melt Electrowritten Scaffolds
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Eingeladene Vorträge / Invited Talks

Stand / As of: 11.03.2026

259
Vorträge / talks

davon / including

52
eingeladene Vorträge / invited talks

207
sonstige Vorträge / other talks
davon **145** Industrievorträge

Patente / Patents

3

Patentanmeldungen /
patent applications

4

erteilte Patente / granted patents
0 in Europa / in Europe
4 international / international

48

Patentfamilien /
patent families

Erteilte europäische Patente / Patents granted in Europe

Erteilte internationale Patente / Patents granted internationally

Südkoreanisches Patent Nr. 102806733 B1
Titel: *„NANOSTRUCTURED COMPOSITE MATERIALS WITH SELF-HEALING PROPERTIES"*
Erfinder: B. Ali, C. Becker-Willinger, J. Brunke

US Patent Nr. 12269951 B2
Titel: *„ NANOSTRUCTURED COMPOSITE MATERIALS WITH SELF-HEALING PROPERTIES"*
Erfinder: B. Ali, C. Becker-Willinger, J. Brunke

Japanisches Patent Nr. 7783749 B1
Titel: *„NOVEL HYDROGELS"*
Erfinder: A. del Campo, A. Farrukh, J.-I. Paez

Japanisches Patent Nr. 7751573 B1
Titel: *„ADHESIVE SYSTEM FOR ROUGH SURFACES"*
Erfinder: E. Arzt, S. Boyadzhieva, R. Hensel, K. Kruttwig, B. Schick, G. Wenzel

Lehrveranstaltungen / Teaching

Wintersemester / Winter semester 2024/2025

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NanoBioMaterialien 1
Universität des Saarlandes, Vorlesung, 2 SWS

Wilfried Weber, Annette Kraegeloh und INM-Kolleg/innen
NanoBioMaterialien-P
Universität des Saarlandes, Praktikum, 4 SWS

Carsten Becker-Willinger
MC07: Technologie der Polymere und Komposite
Universität des Saarlandes, Vorlesung, 2 SWS

Stefan Lohse
"HIV-Infektion", Seminar.Innere Medizin I
Universität des Saarlandes, Seminar, 0.29 SWS

Lola González-García
"Synthesis of Materials and Nanostructures", Master program: Science and Technology of New Materials
University of Sevilla, Seminar, 0.86 SWS

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Material Science Master Praktikum
Universität des Saarlandes, Praktikum, 3 SWS

Roland Bennewitz
Experimentalphysik IV a (Festkörperphysik I)
Universität des Saarlandes, Vorlesung und Übung, 3 SWS

Aránzazu del Campo, Shrikrishnan Sankaran und Mitarbeiter*innen
Biomedizinische Polymere
Universität des Saarlandes, Vorlesung, 2 SWS

Tobias Kraus und Bart-Jan Niebuur (mit G. Jung, C. Kay, Univ. des Saarlandes)
Advanced Topics in Classical Physical Chemistry (PC 03)
Universität des Saarlandes, Vorlesung, 2 SWS

Tobias Kraus (mit G. Jung, C. Kay, S. Stopkovicz, Univ. des Saarlandes)
Advanced Topics in Physical Chemistry (PC 06)
Universität des Saarlandes, Vorlesung, 4 SWS

Tobias Kraus
Functional Coatings (Beschichtungen)
Universität des Saarlandes, Vorlesung und Übung, 4 SWS

Tobias Kraus
Kolloide und Grenzflächen
Universität des Saarlandes, Praktikum, 2 SWS

Tobias Kraus (mit G. Jung, C. Kay, S. Stopkovicz, Univ. des Saarlandes)
Masterpraktikum Physikalische Chemie
Universität des Saarlandes, Praktikum, 2 SWS

Tobias Kraus
Vertiefungspraktikum Werkstoffchemie (WCV)
Universität des Saarlandes, Praktikum, 2 SWS

Volker Presser (mit K. Lienkamp)
Grundlagen der Thermodynamik
Universität des Saarlandes, Vorlesung und Übung, 4 SWS

Volker Presser
Seminar Energie-Materialien
Universität des Saarlandes, Seminar, 2 SWS

Sommersemester / Summer semester 2025

Annette Kraegeloh, Wilfried Weber, Claudia Fink-Straube und Shrikrishnan Sankaran
NanoBioMaterialien-2
Universität des Saarlandes, Vorlesung, 2 SWS

Stefan Lohse
HIV-Infektion, Seminar.Innere Medizin I
Universität des Saarlandes, Seminar, 0.29 SWS

Aránzazu del Campo, Shrikrishnan Sankaran, Sara Trujillo, Wilfried Weber
Engineered Living Materials for Biomedicine
Universität des Saarlandes, Vorlesung, 2 SWS

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Vertiefungspraktikum Biomaterialien
Universität des Saarlandes, Praktikum, 2 SWS

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Vertiefungspraktikum Werkstoffchemie (WCV)
Universität des Saarlandes, Praktikum, 2 SWS

Volker Presser (mit M. Gallei, G. Rizzello, Univ. des Saarlandes)
Smart Materials and Polymers (MC06)
Universität des Saarlandes, Blockvorlesung, 2 SWS

Volker Presser
Seminar Energie-Materialien
Universität des Saarlandes, Seminar, 2 SWS

Lola González-García
Printing of Functional Materials
Universität des Saarlandes, Seminar, 2 SWS

Shrikrishnan Sankaran (mit M. Laschke und Mitarbeiter)
MD/PhD lecture series, 1 Modul
Universität des Saarlandes, Vorlesung, 0,2 SWS

Wintersemester / Winter semester 2025/2026

Lola González-García, Tobias Kraus und INM-Kolleg/innen
NanoBioMaterialien 1
Universität des Saarlandes, Vorlesung, 2 SWS

Lola González-García
NanoBioMaterialien 1, Übung
Universität des Saarlandes, Übung, 1 SWS

Wilfried Weber, Annette Kraegeloh, Lola González-García, Tobias Kraus, Volker Presser, Shrikrishnan Sankaran und INM-Kolleg/innen
NanoBioMaterialien-P
Universität des Saarlandes, Praktikum, 4 SWS

Annette Kraegeloh (Organisation durch C. M. Lehr, M. Schneider)
Introduction to Drug Delivery and NanoBiomedicine
Universität des Saarlandes, Vorlesung, 0.2 SWS/2 SWS

Carten Becker-Willinger
MC07: Technologie der Polymere und Komposite
Universität des Saarlandes, Vorlesung, 2 SWS

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Experimentalphysik IV a (Festkörperphysik I)
Universität des Saarlandes, Vorlesung und Übung, 3 SWS

Aránzazu del Campo, Shrikrishnan Sankaran und Mitarbeiter*innen
Biomedizinische Polymere
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Stefan Lohse
HIV-Infektion, Seminar.Innere Medizin I
Universität des Saarlandes, Seminar, 0.29 SWS

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Advanced Topics in Classical Physical Chemistry (PC 03)
Universität des Saarlandes, Vorlesung, 2 SWS

Tobias Kraus (mit G. Jung, C. Kay, S. Stopkovicz, Univ. des Saarlandes)
Advanced Topics in Physical Chemistry (PC 06)
Universität des Saarlandes, Vorlesung, 4 SWS

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Universität des Saarlandes, Praktikum, 2 SWS

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Vertiefungspraktikum Werkstoffchemie (WCV)
Universität des Saarlandes, Praktikum, 2 SWS

Guido Kickelbick, Tobias Kraus, Markus Gallei und Volker Presser
Raw Materials and Resources
Universität des Saarlandes, Vorlesung, 2 SWS

Volker Presser
Seminar Energie-Materialien
Universität des Saarlandes, Seminar, 2 SWS

Michael Elsaesser und Volker Presser
Chemistry of Materials I
Universität Salzburg, Vorlesung, 2 SWS

Lola González-García
Synthesis of Materials and Nanostructures, Master program: Science and Technology of New Materials
University of Sevilla, Seminar, 0.85 SWS

Lola Gonzalez-Garcia und Mitarbeiter/innen
Material Science Master Praktikum
Universität des Saarlandes, Praktikum, 3 SWS

Veranstaltungen / Events

Nano tech 2025
C. Becker-Willinger, Th. Müller
Tokyo, 29. – 31.01.2025

INM Colloquia Day - Accelerated Research in Materials Science
A Banderas, A Del Campo, W. Weber
Saarbrücken, 11.02.2025

Besuch einer Gruppe von der Dalian University of Technology
M. Quilitz, W. Weber (mit Universität des Saarlandes)
Saarbrücken, 12.02.2025

Besuch einer Studentengruppe von der Calgary Universität
R. Bennewitz, T. Kister, T. Kraus, B. J. Niebuur, M. Quilitz, W. Weber
Saarbrücken, 19.02.2025

LOPEC 2025
M. Laguna Moreno, M. Lay, C. Kaiser
München, 25. – 27.02.2025

European Coatings Show 2025
C. Becker-Willinger (mit Cluster Nanotechnologie)
Nürnberg, 25. – 27.03.2025

Girls`Day 2025 – Mit Genschere und Silberspiegel im Labor
S. Schumacher, S. Siegrist
Saarbrücken, 03.04.2025

Workshop 3D Visualization and Analysis using Zeiss Arivis Pro
C. N. Duong
Saarbrücken, 15.04.2025

Besuch einer Gruppe von FachschaftsvertreterInnen im Rahmen der "Konferenz aller Werkstofftech-nischen und Materialwissenschaftlichen Studiengänge (KaWuM)" an der Universität des Saarlandes
S. Arnold, S. Brück, A. Burgstaller, S. Lohse, V. Presser, M. Quilitz, L Teruel, W Weber (mit Universität des Saarlandes)
Saarbrücken, 09.05.2025

Joint Colloquia Series Data-driven Materials Science
A. Del Campo, A Sharma, W. Weber (mit Universität des Saarlandes)
Saarbrücken, 12. 05. – 13.05.2025

Gemeinsamer Stand von Leibniz-Gemeinschaft und INM im Rahmen der KOWI-Veranstaltung „Research in Europe“ an der Universität des Saarlandes
M. Quilitz (mit Geschäftsstelle der Leibniz-Gemeinschaft, Universität des Saarlandes und Kooperationsstelle EU der Wissenschaftsorganisationen)
Saarbrücken, 15.05.2025

Tag der Offenen Tür im Rahmen des Tages des Offenen Campus der Universität des Saarlandes
C. Hartmann, T. Kraus und Team, V. Presser und Team, M. Quilitz. S. Sankaran und Team, W. Weber und Team
Saarbrücken, 24.05.2025

Joint Colloquia Series Biomedical Device Engineering
A Del Campo, A Sharma, W. Weber (mit Universität des Saarlandes)
Saarbrücken, 26. & 27.05.2025

Symposium G Flexible, stretchable and printable electronic materials for sustainable healthcare, sensing and actuators, energy applications and interconnectors im Topic "Nanocomposites and Hybrid Materials" auf der E-MRS Spring Meeting 2025
T. Kraus (Main Organisation)
Straßburg, France, 26. – 30.05. 2025

Workshop Basic Microscopic Image Processing and Analysis
C. N. Duong
Saarbrücken, 10.06. – 11.06.2025

Besuch von Teilnehmenden des EUSMAT Alumni Network Meeting an der Universität des Saarlandes
V. Presser, M. Quilitz (mit Universität des Saarlandes)
Saarbrücken, 26.06.2025

Laser World Of Photonics 2025
S. Brück, J. Feng, C. Kaiser, P. Rogin (mit Universität des Saarlandes)
München, 22. – 25.06.2025

Meet the Scientists
V. Presser
MS Wissenschaft Tour 2025
Duisburg, 29.06.2025

Besuch einer Gruppe von der Tongji University, Shanghai, China
S. Brück und Team DBM, S. Lohse und Team MSB, M. Quilitz (mit Prof. B. Qu, Universität Osnabrück)
Saarbrücken, 09.07.2025

Besuch von Teilnehmenden der Summer School für Studierende der Kyung Hee University, Seoul, Korea an der Universität des Saarlandes
M. Quilitz (mit Universität des Saarlandes)
Saarbrücken, 15.07.2025

Meet the Scientists
S. Arnold
MS Wissenschaft Tour 2025
Saarbrücken, 24.07.2025

Besuch von Teilnehmenden einer Veranstaltung des EU Start-Up Accelerator Programms an der Universität des Saarlandes
M. Quilitz (mit Universität des Saarlandes, Triathlon)
Saarbrücken, 26.08.2025

Besuch von Teilnehmenden der EUSMAT Intergration Week des AMASE Programms 2025 an der Universität des Saarlandes
S. Arnold, M. Quilitz (mit Universität des Saarlandes)
Saarbrücken, 27.08.2025

BMFTR Virtual Lab Day
M. Quilitz (mit VDI, BMFTR)
virtuell, 18.09.2025

Next Gen Materials 2025
A. del Campo (Conference Chair, Program Committee), W. Weber (Program Committee)
Hybrid conference
Deutsche Gesellschaft für Materialkunde, DGM
Hamburg, Germany, 23. – 25.09.2025

TechTransfer Day
Smart Contact Lenses: Embedded Technologies beyond Vision
A. del Campo und Team, C. N. Duong, H. Jahn-Kelleter, C. Kaiser, C. Hartmann
Transfer Event
Saarbrücken, 29. – 30.09.2025

Feierlichkeiten zum Tag der Deutschen Einheit 2025 im Saarland, Präsentation diverser Gruppen sowie des INM an den Ständen der Universität des Saarlandes
A. del Campo und Team, C. Hartmann, T. Kraus und Team, V. Presser und Team, M. Quilitz, S. Sankaran und Team, W. Weber und Team (mit der Universität des Saarlandes)
Saarbrücken, 02.10. – 04.10.2025

Treffen der Koordinatoren der Leibniz-WissenschaftsCampi am INM
A. Banderas, K. Desai, H. Jahn-Kelleter, C. Kaiser, C. Müller, M. Quilitz, S. Sankaran, A.-C. Schlapp, Th. Steudter (mit Geschäftsstelle der Leibniz-Gemeinschaft)
Saarbrücken, 07.10.2025

Cell Physics Conference 2025
O. Staufer (Organizing Committee)
Deutsche Gesellschaft für Zellbiologie
Saarbrücken, 07.10. – 09.10.2025

BMFTR SchülerInnenpraktikum Werkstoffferien 2025
S. Arnold, G. Asensio Martin, S. Brück, Y. Curto, R. Drumm, A. Haettich, N. Hautz, A. Kraegeloh, H. Mayer, Th. Mueller, B. Nothdurft, M. Quilitz, S. Schumacher, K. Sorg, Th. Steudter (mit VDI, BMFTR)
Saarbrücken, 13.10. – 17.10.2025

Workshop From Pixels to Patterns: Applying Machine Learning Tools for Advanced Image Analysis
C. N. Duong
Saarbrücken, 03.11. – 04.11.2025

MEDICA
G. Asensio-Martin, C. Kaiser, S. Krauser
Düsseldorf, 17.11. – 20.11.2025

TechTransfer Day
Living Therapeutics
A. del Campo und Team, H. Jahn-Kelleter, S. Sankaran
Transfer Event
Saarbrücken, 19.11.2025

Besuch einer Gruppe von Studierenden der HBK Saar
G. Asensio-Martin, H. Mayer, M. Quilitz, L. Teruel Enrico
Saarbrücken, 08.12.2025

INM-Kolloquien / INM Colloquia

Dr. Stephane Lemaire
Paris Biofoundry: Making biology easier and faster to engineer
Biofoundry, Universite Sorbonne, Paris, France
04.02.2025
Host: Prof. Dr. Wilfried Weber, Dr. Alvaro Banderas

Prof. Dr. Alfred Ludwig
Materials Discovery and Interfaces
Ruhr University, Bochum, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Dr. Özlem Özcan
Materials and Surface Technology
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Dr. Vahid Babaei
Artificial Intelligence aided Design and Manufacturing
Saarland Informatics Campus, Saarbruecken, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Prof. Dr. Stefan Sandfeld
Institute for Advanced Simulation, Materials Data Science and Informatics
Forschungszentrum Juelich, Juelich, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Dr. Alvaro Banderas
Accelerated Research Foundry
INM – Leibniz Institute for New Materials, Saarbruecken, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Prof. Dr. Kerstin Thurow
Center for Life Science Automation
University of Rostock, Rostock, Germany
11.02.2025
Contribution to INM Colloquia Day on 11.02.2025

Prof. Dr. Michael Wiertlewski
Altering the tactile perception of surfaces with waves
TU Delft, Delft, Netherlands
07.05.2025

Prof. Dr. Ali Yetisen
Photonic Biosensing Technologies for Precision Medical Diagnostics
Imperial College, London, UK
30.09.2025

Prof. Dr. Oliver Gutfleisch
Photonic Biosensing Technologies for Precision Medical Diagnostics
Technical University Darmstadt, Darmstadt, Germany
21.10.2025

Gemeinsame Kolloquien mit der Fakultät Mathematik & Informatik der Universität des Saarlandes / Joint Colloquia Series with the Faculty of Mathematics & Coumputer Science of Saarland University and the DFKI / German Research Center for Artificial Intelligence

Dr. Kevin Maik Jablonka
Encoding and Decoding Materials with Transformers
Friedrich Schiller University Jena
Saarbrücken, 05.05.2025

Dr. Orkun Furat
Combining data-driven stochastic 3D modeling with methods from AI for designing materials with optimized functional properties
University of Ulm
Saarbrücken, 12.05.2025

Dominik Klemens Klein
Physics-augmented data-driven material modeling
Technical University of Darmstadt
Saarbrücken, 12.05.2025

Dr. Viacheslav Slesarenko
From static materials to AI-driven adaptive systems
University of Freiburg
Saarbrücken, 13.05.2025

Dr. Viktor Zaverkin
Machine Learning for Computational Materials Design
NEC Laboratories Europe GmbH, Heidelberg
Saarbrücken, 13.05.2025

Gemeinsame Kolloquien mit der Fakultät Medizin der Universität des Saarlandes / Joint Colloquia Series with the Faculty of Medicine of Saarland University

Prof. Huanyu “Larry” Cheng
Standalone stretchable device platform for Biomedicine
The Pennsylvania State University, USA
Saarbrücken, 26.05.2025

Prof. Ghulam Destgeer
From Lab on a Chip to Lab on a Particle: Engineering Microfluidic Devices for Biomedical Application
Technical University of Munich, Germany
Saarbrücken, 26.05.2025

Prof. Andreas Güntner
Molecular Sensors for Healthcare: From Nanotechnology to Devices
ETH Zürich, Switzerland
Saarbrücken, 26.05.2025

Prof. Sebastian Kruss
Fluorescent nanosensors for biomedical diagnostics
Bochum University, Germany
Saarbrücken, 27.05.2025

Prof. Alexey Tarasov
Graphene-based Biosensors for Biomedical Applications
University of Applied Sciences Kaiserslautern, Germany
Saarbrücken, 27.05.2025

Das INM in den Medien / INM in the Media

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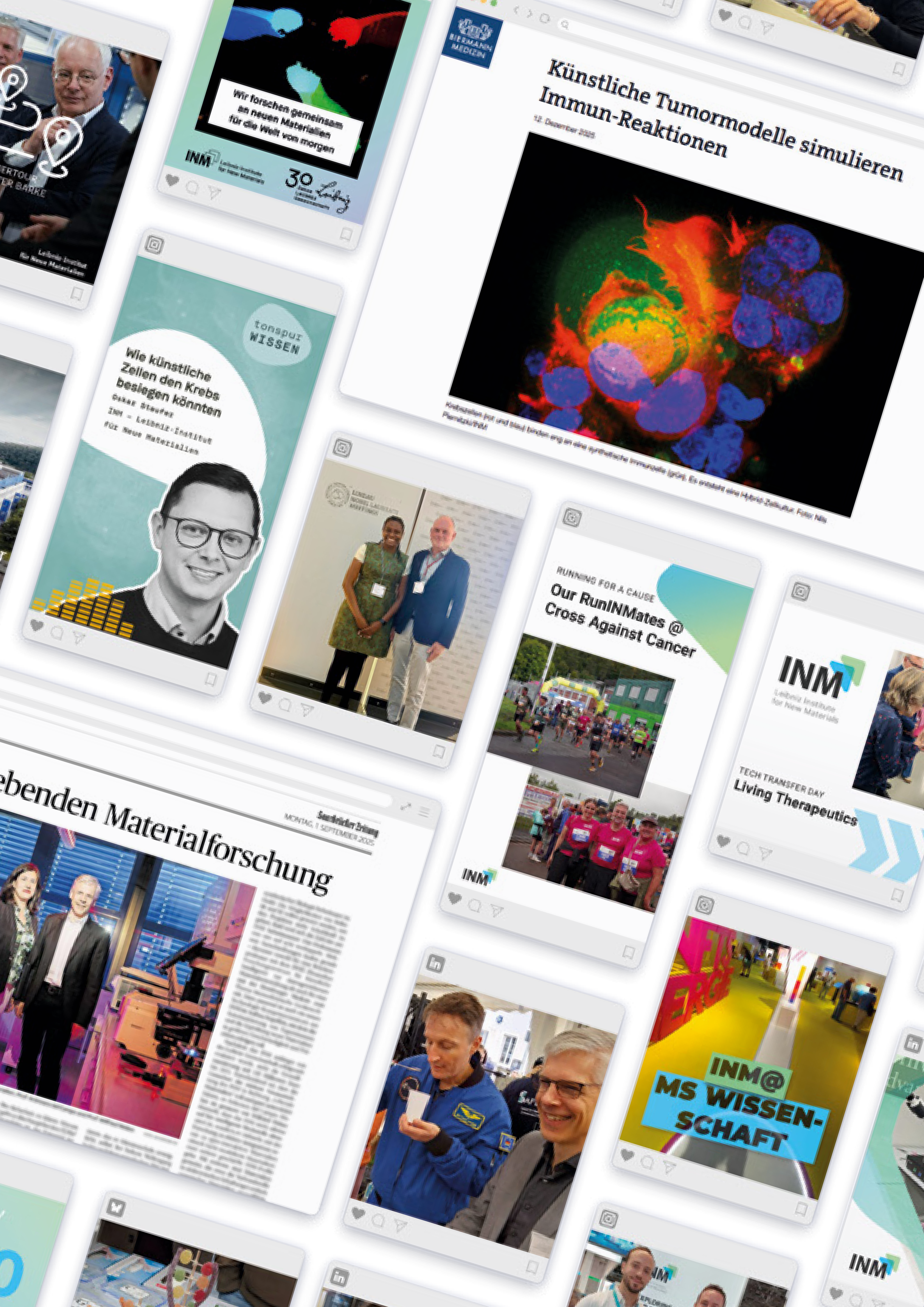
BIERMANN MEDIZIN
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tonspur WISSEN
Wie künstliche Zellen den Krebs besiegen könnten
Oskar Staufer
INM – Leibniz-Institut für Neue Materialien
RUNNING FOR A CAUSE
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Status: As of 31.12.2025

Impressum / Imprint

Für den Inhalt verantwortlich / Responsible for the content: Prof. Dr. Wilfried Weber, Prof. Dr. Aránzazu del Campo, Michael Marx

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Korrektur / Correction: Dr. Stefanie Arnold, Yannic Curto, Dr. Kira Fries, Christine Hartmann, Dr. Peter König, Therese Steudter

Grafik / Graphics: Lars Knaack

Layout & Typesetting: FBO GmbH – Agentur für Marketing und Neue Medien, Saarbrücken

Druck / Printing: repa Druck GmbH, Saarbrücken

Fotos / Photos: INM, außer / *INM, except*:
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Geschäftsführung: Prof. Dr. Wilfried Weber (Vorsitz),
Prof. Dr. Aranzazu del Campo, Michael Marx

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ISSN: 1864-255x