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FRAUNHOFER INSTITUTE FOR PRODUCTION TECHNOLOGY IPT

ANNUAL REPORT 2018

ANNUAL REPORT
2018

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FOREWORD

Dear readers and friends of the Fraunhofer IPT,

2018 was a year of both change and continuity for the Institute. Fritz Klocke's move to Stuttgart not only allowed me to step into his shoes as the head of the Fraunhofer IPT, it also triggered a series of other boardroom changes: Thomas Bergs, following a 16-year period as the Managing Chief Engineer of the Fraunhofer IPT, took over the Chair of Manufacturing Technology at the WZL of the RWTH Aachen University and has moved to the Fraunhofer IPT's Executive Board. His successor as the Managing Chief Engineer of the Fraunhofer IPT is Christoph Baum who will support me in my tasks of coordinating the strategies and the operations of our Institute.

Networked adaptive production: this has been the leitmotif of many of our recent activities. This focus was instrumental in the approval of our "Cluster of Excellence" for the development of the Internet of Production, but our latest agenda already includes two additional strategic research priorities: Firstly, there is research on biological transformation, the targeted use of biological principles such as artificial intelligence and evolutionary adaptation mechanisms for the purpose of optimizing production processes. This is a field that has attracted a lot of attention within the Fraunhofer-Gesellschaft recently. Secondly, there is our research into the mass series production of components for automotive powertrains under the motto "Future Powertrain". We are aiming to design efficient production technologies that look capable of contributing to the development of e-mobility into a key technology for the future – by coming up with innovative energy storage systems and fuel cells as well as high-performance electric engines and transmission technology.

Another milestone of the past year was the installation of 5G wireless technology in the machine hall's production environment by our partners from Ericsson. Since February 2018, the facility has been transmitting large amounts of production data from manufacturing processes to our IT infrastructure. By introducing our newly established "International Center for Networked Adaptive Production" (ICNAP) to the visitors of the Hannover Messe, we immediately managed to attract the attention of companies that are interested in joining us for further explorations of this technology's huge potentials. By the end of the year, 14 business partners had already committed themselves to this project and will now, together with us and the two other Aachen-based Fraunhofer Institutes ILT and IME, conduct further trials and experiments to find out what opportunities there are for the integration of 5G into modern production lines.

At the same time, 2018 was also a year of continuity. As my predecessor Fritz Klocke loved to emphasize in his introductions to past Annual Reports: The success of the Fraunhofer IPT is, above all, the product of a joint effort. Our highly motivated and highly skilled members of staff are willing go the extra mile, day after day, and this has created the Institute's unique working culture, which I was privileged to experience from a new perspective over the past year. I would like to thank all of my colleagues who have contributed to the Fraunhofer IPT's success story, also on behalf of my fellow directors Thomas Bergs, Robert Schmitt and Günther Schuh.

Last but not least, we also owe a debt of gratitude to our loyal customers and business partners who have once again demonstrated their interest in our research and development efforts. We are looking forward to continuing our relationship on a foundation of mutual trust. I am confident that the new year will bring us many more exciting and successful research projects and that the spirit of good cooperation will continue to define our Institute's working culture.

Aachen, March 2019

Prof. Dr.-Ing. Christian Brecher

From left to right:
Prof. Dr.-Ing. Dr.-Ing. Thomas Bergs MBA
Prof. Dr.-Ing. Robert Schmitt
Prof. Dr.-Ing. Dipl.-Wirt. Ing. Günther Schuh
Prof. Dr.-Ing. Christian Brecher

THE FRAUNHOFER IPT: A PROFILE IN TECHNOLOGY

The Fraunhofer IPT is developing system solutions for networked adapted production. More than 470 members of our research and development staff are conducting virtual and simulation-assisted trials to meet the challenge of breaking down technologically innovative production schedules for complex components and products into individual production steps and integrated process chains before implementing these schedules in a flexible network of machines, integrated facilities and software systems.

Our work is based on the combination of manufacturing machinery and software systems with intelligent sensor and cybernetic equipment to enable the continuous collection and communication of process data.

For the purposes of our research, we assume the perspective of manufacturing enterprises, understanding production not as the mere sum of individual process steps but as an integrated and complex system. We pay particular attention to the joints between the individual links of the process chain, in research and development, the procurement of the various raw materials or services and in the manufacturing process itself.

The skills portfolio of the Fraunhofer IPT includes the evaluation and design of technologies and process chains, the development of industrial planning and control concepts, of interfaces and data structures as well as the design of networked and adaptable software systems for simulations, analyses and quality control processes in industrial manufacturing environments. At the same time, we keep an eye on all relevant business and management processes, continuously adding new methods of how to improve the organization of production operations. This approach enables us to go beyond the development of highly specialized individual technologies, creating – for the benefit of our clients – workable system solutions today for tomorrow's "Internet of Production".

Industries, Products and Technologies

For the benefit of certain industries and product groups, we can also establish cross-departmental task forces that combine the skills and competences of different business units: our membership in various networks of science and industry as well as our background of close cooperation with our partners within the Fraunhofer-Gesellschaft and the RWTH Aachen University enable us to search for innovative solutions across the frontiers of conventionally defined areas of research activity. Our research focuses specifically on the following industries, technologies and product groups:

- Automotive industry including suppliers
- Energy production and energy storage systems
- Life Sciences
- Special purpose machines and facilities
- Optics and optical systems technology
- Turbomachinery manufacturing
- Tool and die making

Cutting Edge Technologies

With our technologically sophisticated fleet of integrated machinery networks and many years of experience in all fields of production technology, we have the resources that are required to develop and to optimize methods, technologies and processes for the production of high-tech components and products in close cooperation with our project partners and clients in government-sponsored as well as commercially funded projects. Our laboratories and machine halls are full of top-of-the-range technology and occupy 5000 m², nearly half of the Fraunhofer IPT's total floor space of approx. 9000 m².


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PEOPLE AT THE FRAUNHOFER IPT

The human face of the Fraunhofer IPT changed significantly over the past year: at the very top of the management pyramid, elsewhere in the boardroom, and in many of the individual departments and business units. New faces were welcomed all across the Institute.

Prof. Dr.-Ing. Christian Brecher
was appointed the new Head of the Fraunhofer IPT, succeeding Professor Fritz Klocke with effect from 1 January 2018.

Dr.-Ing. Christoph Baum
succeeded Professor Thomas Bergs as the Chief Managing Engineer of the Fraunhofer IPT as per 1 June 2018.

Prof. Dr.-Ing. Thomas Bergs MBA
took over the WZL Chair of Manufacturing Technology from Professor Fritz Klocke as per 1 June 2018 and also succeeded him as the Fraunhofer IPT's Director of the Division for Process Technology.

Daniel Zontar
succeeded Dr. Christoph Baum as Head of the Department for Precision Technology and plastics replication as per 1 July 2018.

Thomas Vollmer
is the new Head of the Department for Production Quality, succeeding as per 1 April 2018 Dr. Eike Permin who took over a job in industry.

Dr.-Ing. Ramon Kreutzer
took over the Department for Strategic Technology Management from Markus Wellensiek on 1 January 2019.

Tobias Müller
succeeded Dr. Reik Krappik as the Manager of the Business Unit for Optics as per 1 October 2018.

Patrick Scholz
succeeded Stephan Schröder as the Manager of the Business Unit for Lightweight Production Technology as per 1 January 2019.

ORGANIZATIONAL CHART

Executive director
Prof. Dr.-Ing. Christian Brecher

Managing chief engineer
Dr.-Ing. Christoph Baum

Process technology

Prof. Dr.-Ing. Thomas Bergs MBA

Production machines

Prof. Dr.-Ing. Christian Brecher

Production quality and metrology

Prof. Dr.-Ing. Robert Schmitt

Fine machining and optics

Tim Grunwald M.Sc.

Precision technology and automation

Daniel Zontar M.Sc.

Production quality

Dipl.-Wirt.-Ing. Thomas Vollmer

High performance cutting

Dr.-Ing. Florian Degen

Fiber-reinforced plastics and laser systems technology

Dipl.-Ing. Dipl.-Wirt. Ing.
Henning Janssen

Production metrology

Dipl.-Phys. Niels König

Non-conventional manufacturing processes and technology integration

Dr.-Ing. Kristian Arntz

Board of directors

Prof. Dr.-Ing. Thomas Bergs MBA, Prof. Dr.-Ing. Christian Brecher,
Prof. Dr.-Ing. Robert Schmitt, Prof. Dr.-Ing. Dipl.-Wirt. Ing. Günther Schuh

Technology management

Prof. Dr.-Ing. Dipl.-Wirt. Ing.
Günther Schuh

Strategic technology management

Ramon Kreutzer M.Sc.

Operative technology management

Dipl.-Ing. Toni Drescher

Services

Dr.-Ing. Christoph Baum

Administration

Josef von Heel

IT

Jacqueline Barby

Building services

Dipl.-Ing. (FH) Dirk Nehr

External and internal communications

Susanne Krause M.A.

Cross-institute activities

Dr.-Ing. Christoph Baum

Strategic research planning

Dipl.-Ing. Axel Demmer

Strategic business planning

Dipl.-Ing. Torsten Moll

High performance center "Networked adaptive production"

Dipl.-Ing. (FH) Mario Pothen M.Sc.

Strategic large-scale projects and project centers

Dr.-Ing. Christoph Baum

April 2019

BOARD OF TRUSTEES

Each of the Fraunhofer Institutes has a Board of Trustees to advise the management of the Institute and the Management Board of the Fraunhofer-Gesellschaft. They include personalities from academic life, business and government. The members of the Board of Trustees of the Fraunhofer IPT in the year under review were as follows:

Chairman of the Board of Trustees

Dr.-Ing. Stefan Nöken
Hilti AG, Schaan/Liechtenstein

The members of the Board of Trustees

Prof. Dr.-Ing. Kirsten Bobzin
Surface Engineering Institute, RWTH Aachen University

Dr.-Ing. Uwe H. Böhlke
Oerlikon Balzers Coating AG, Balzers/Liechtenstein

Dr. Helmut Bossy
Bundesministerium für Bildung und Forschung, Berlin

Hans-Dieter Franke
Management Partner MPower GmbH, Winnen

Felix Hoben
Carl Zeiss Industrielle Messtechnik GmbH, Oberkochen

Dr.-Ing. Rainer Martens
MTU Aero Engines AG, München

Manfred Nettekoven
Chancellor of the RWTH Aachen University

Prof. Dr.-Ing. habil. Ansgar Trächtler
Fraunhofer Institute for Mechatronic Systems Design, Paderborn

THE FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 72 institutes and research units. The majority of the more than 26,600 staff are qualified scientists and engineers, who work with an annual research budget of 2.6 billion euros. Of this sum, 2.2 billion euros is generated through contract research. Around 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Around 30 percent is contributed by the German federal and state governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

72

Research institutes and facilities in Germany

Research volume

2.6

billion Euros

2.2 billion Euros
Contract research

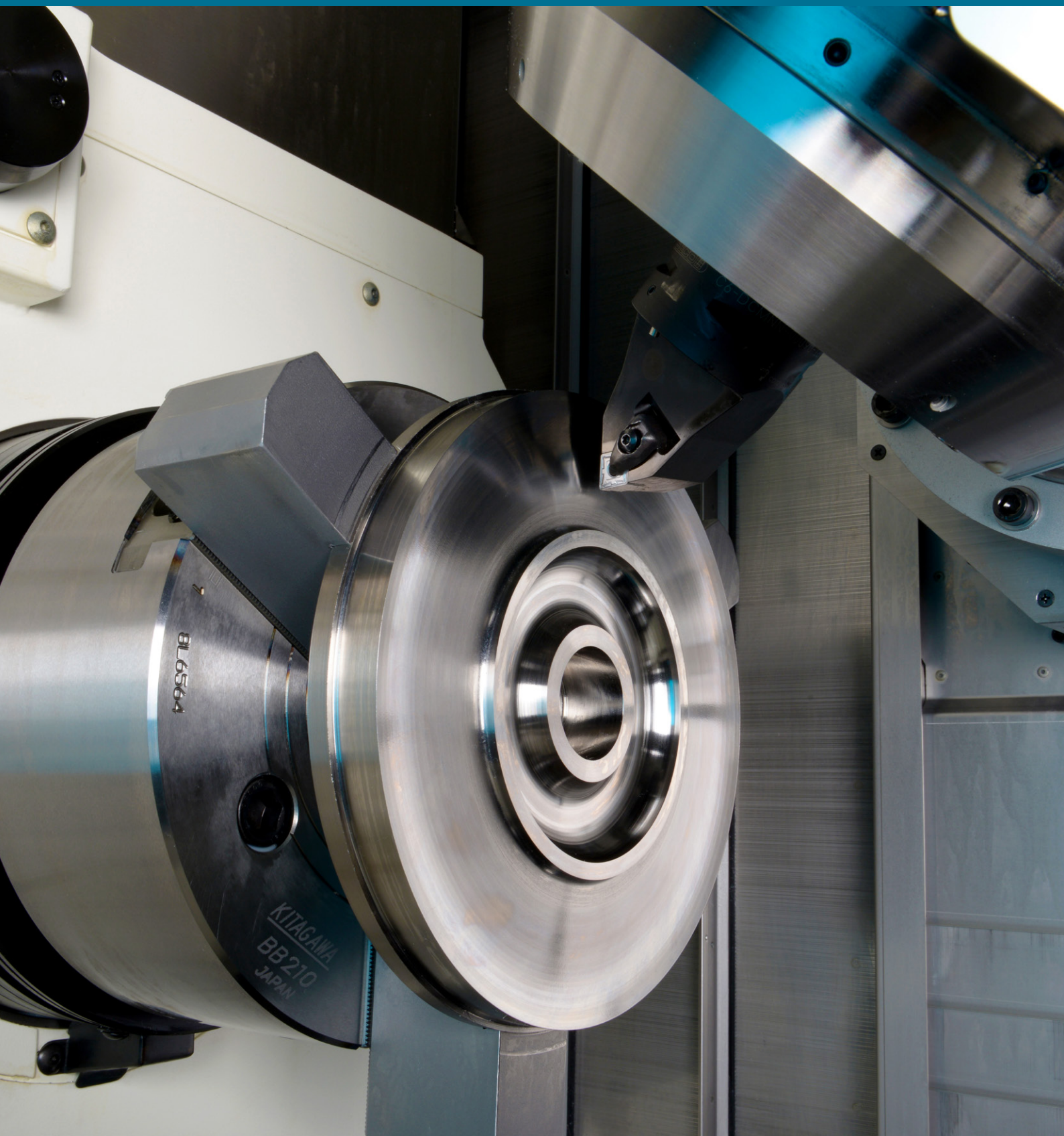
Industrially and publicly funded research projects 70%

30% Federal funding

more than

26,600

employees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EQUIPMENT

Our laboratories and production facilities feature state of the art technology and cover an area of 5000 m². We put great importance on our continuous contacts and exchanges with industrial corporations and the permanent updating of our equipment. In the year 2018 we invested an amount of 1.5 Mio Euro for machinery and infrastructure.

Machinery

Turning and milling machines

- **Alzmetall GS 100**
  5-axis milling machine for metal processing
- **Alzmetall GX 1000/5-FDT**
  5-axis machining center for highly dynamic milling and turning operations
- **Chiron FZ15S**
  3-axis machining center with ultrasonic unit and cryogenic cooling
- **DMG HSC 55**
  3-axis milling, turning and drilling center
- **FFUP**
  Ultraprecision turning machine for fast-tool machining of free forms
- **Heller MC 25**
  5-axis horizontal machining centre with pallet changer
- **KERN**
  3-axis high-precision milling machine
- **KERN Micro**
  5-axis machining center for high-precision micro-machining
- **Makino D500**
  5-axis machining center for high-precision milling operations
- **Mikron HPM 800U HD**
  5-axis machining center for highly dynamic milling operations
- **Monforts UniCen 1000 MultiTurn**
  High-performance turning center with milling head and counter spindle
- **CNTX 2000**
  Turning/milling center with counter spindle for 5-axis simultaneous machining
- **Precitech DLM**
  Ultra-precision lathe for diamond machining of rolls
- **Precitech Nanoform 250**
  Ultra precision lathe for diamond machining
- **Starrag LX 021**
  5-axis blade machining center

Machinery for the production of fiber composite components

- **Infrared thermoforming test bench**
- **Kuka 360-2**
  Industrial robots
- **Lauffer VA 850**
  Laminating press, 850 t
- **Micro pullwinding plant**
- **Micro-pultrusion line**
- **PrePro2D**
  IR-2D tape laying testbed
- **PrePro3D**
  Multi-material-head tape laying/winding system

Grinding and polishing machines and systems

- **ABB IRB 4400 (Cells 1+2)**
  Robot cell for automated fine machining (grinding, lapping and polishing)
- **iOptic diamond processing**
  Ultra precision grinding machine for the machining of diamond lenses
- **Moore Nanotech 350 FG**
  Ultra precision grinding and turning machine
- **Phoenix 4000**
  Loaboratory polishing machine
- **Symplexity**
  Robot cell
- **Synchro speed 120SL**
  Polishing machine

- **Walter Helitronic Vision 400**
  High-performance tool grinding machine
- **Wolters AC 530 • P**
  Two-side lapping and polishing machine

Laser processing equipment

- **Aerotech laser structuring system**
  Portal system with coupled mechanical and optical axes and short pulse laser, 70 W
- **Alzmetall GX 1000/5-T-LOB**
- **Held Typ Varilas**
  Laser processing systems (Station 2 / 3)
- **Kern Evo**
  Laser structuring system
- **Mikron HSM 600U**
  Laser structuring system
- **Monforts RNC 400 Laser Turn**
- **Test bench for laser soldering**
- **Test benches for laser beam ablation**
- **ROFIN RSM PowerlineE**
  Laser marking system
- **Satisloh GI-3PL**
- **Struers Discotom-2**
  Cutting machine
- **Dual Beam Optics with Edgewave LaserIS201-ET**
  Pulse Laser Ferropulse

Laser systems

- **CO2 laser**
- **Trumpf TruCoax 2000, 2 kW**
- **Diode laser systems**
- **Laserline diode laser LDF 1000-2500, 2.5 kW**
- **Laserline diode laser LDF 3000-40, 3 kW**
- **Laserline diode laser LDF 4500-30, 4.5 kW**
- **Fiber laser**
- **IPG YLR-6000-S2, 6 kW**
  Polishing machine
- **IPG YLS-30000-S2, 30 kW**
  Short pulse lasers in the pico and nanosecond range

Punching lines and presses

- **Sheet metal processing test stand (28 t automatic punching press)**
  Basic investigations with laser, induction and conduction heating
- **Schuler MSC 2000, press force 200 t**
  Press line with reel, straightening line and servo press for thermal-assisted sheet metal processing

Equipment for optics replication of glass and plastics

- **ATV PHP630 LTCC sinter press**
  Glass press for applications in microelectronics
- **ELINO**
  Test bench for tool life determination of tools for glass forming
- **Füller**
  Non-isothermal glass press
- **Nabertherm**
  Annealing furnace for formed glass components
- **Toshiba GMP – 207 HV**
  High temperature precision glass press
- **Toshiba GMP – 211 V**
  Precision glass press

Plastic injection molding machines

- Arburg 220S with handling system
- Arburg 270A
- Arburg 720A with handling system and clean room

Plants for the production of functional foils

- **Coatema CC09**
  Roll-to-roll system for UV-based film structuring processes
- **Häcker VICO Laser**
  Automated placement system
- **Reko 3 (self-made)**
  Recombination hot stamping machine for step-and-repeat processes
- **Roll-to-roll system**
  Multifunctional, continuous production line for structuring and functionalizing polymeric substrate webs

Assembly plants

- **Basic machine 16.01 (self-made)**
  3-axis mounting cell for wafer mounting
- **Basic machine 16.01 (self-made)**
  3-axis assembly cell for micro-assembly
- **Häcker VICOxTec**
  3-axis assembly cell
- **Micro Cell**
  3-axis assembly cell

Water jet systems

- **Test bench Synova / Lee Laser**
- **Ridder HWE-P2030/1-3D/DH**
  5-axis high-pressure water jetting system

Coating plant

- **CemeCon CC800/9 Custom**
  PVD coating system

ECM/EDM systems

- **EMAG PO100 SF**
  Electrochemical metalworking
- **Makino U6 Heat EDM**

Metrology and testing equipment

Coordinate metrology equipment

- **Werth Video-Check UA**
- **Zeiss Prismo VAST 09/15/07**
- **Zeiss O-Inspect 01-442**

Materials testing

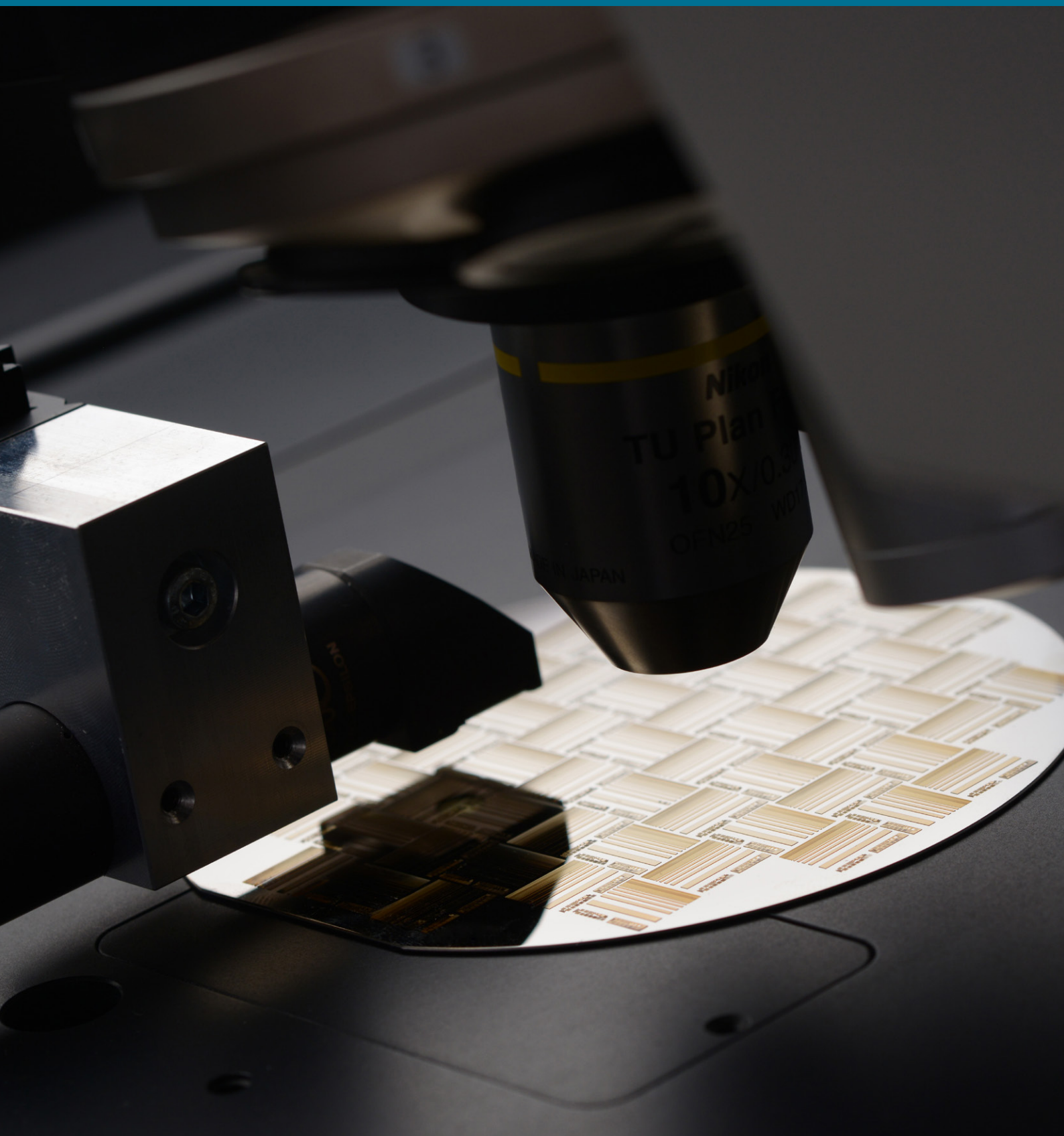
- **Ilis StrainMatic M4/100**
- **Leco M-400-H**
- **Oxford INCA**
- **Trioptics Wave Master LAB**
- **Wilson Hardness UH250**
- **Zwick Roell Z250**

Optical surface inspection

- **Alicona IFSensor R25**
- **Alicona Infinite Focus G5**
- **Avantes AvaSpec-Dual, AvaSphere-50-LS-MAL**
- **Bruker Contur GT-K**
- **Bruker NP Flex**
- **DataPhysics OCA 20LHT**
- **FRT MicroProf**
- **GOM ATOS Core**
- **Nanofocus µSurf Custom**
- **Sios NMM-1**
- **Steinbichler Comet 5 11Ma**
- **Thorlabs Telesto**
- **Zeiss T-Scan LV**
- **Zygo Verifire AT+**
- **3D Shape SpecGAGE3D**

Tactile surface testing

- **Mahr MMQ400**
- **Mahr LD260**
- **Taylor-Hobson Talyrond 262**


Nikon
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- **Taylor-Hobson Talysurf PGI1250**
- **Taylor-Hobson Talysurf Series 2**

Laser metrology

- **Coherent PowerMax-USB/RS**
- **Dr. Mergenthaler LASCON LPC03-3**
- **Primes FocusMonitor**
- **Primes MicroSpotMonitor MSM**
- **Primes PocketMonitor**
- **Thorlabs Photodioden**

Mikroskope

- **Keyence VHX6000 (und weitere)**
- **Leica M80**
- **Leica M205A**
- **Zeiss AxioImager.A1M**
- **Zeiss AxioImager.M2M**
- **Zeiss Axiophot**
- **Zeiss Neon 40 EsB**
- **Leica DM RXE**

Machine calibration

- **Etalon AG LaserTRACER**
- **IBS Precision Engineering Trinity Probe**
- **StatusPROGmbH µLine 30**

Scales and small devices

- **FLIR Thermo-Kamera**
- **InfraTec VarioCAM HD head**
- **Kistler Typ 9121, 9129 AA, 9254, 9255, 9255 Asp, 9255 B, 9257 A, 9257 B, 9273**
- **Linseis L75HD 1000 LT**
- **Mettler PM1200, PE600, PE6000**
- **Mitutoyo PJ-H30**
- **Nikon V12**
- **Z-Mike 1120**

Smart devices and input devices

- **65"-4K Multitouch Screen iiyama PROLITE TF6537UHSC-B2AG**
- **Epson BT-300**
- **Estimote Beacons**
- **HTC Vive**
- **Google Glass 2**
- **Leap Motion**
- **Microsoft Hololens**
- **ODG R7**
- **Vuzix M300**

Other

- **DIWire Pro**
  Tabletop CNC wire bending machine
- **Basic test bench**
  Highly dynamic linear machining system for machinability investigations
- **Conduction generator for conductive heating of sheet metal, 40kW**
- **Trumpf Hüttinger BIG 50/100, 50 kW**
  Induction generator for heating sheet metal
- **MIRA: Multi-Technology Robot System for Adaptive Manufacturing**
  Robot cell
- **Vibration test rig**
  Experimental dynamic investigations of workpieces, tools and clamping systems
- **UHM**
  Planing and fly-cutting machine for ultra-precision machining of large-area components
- **Walter Helicheck Plus**
  4-axis CNC measuring machine for the complete measurement of tools

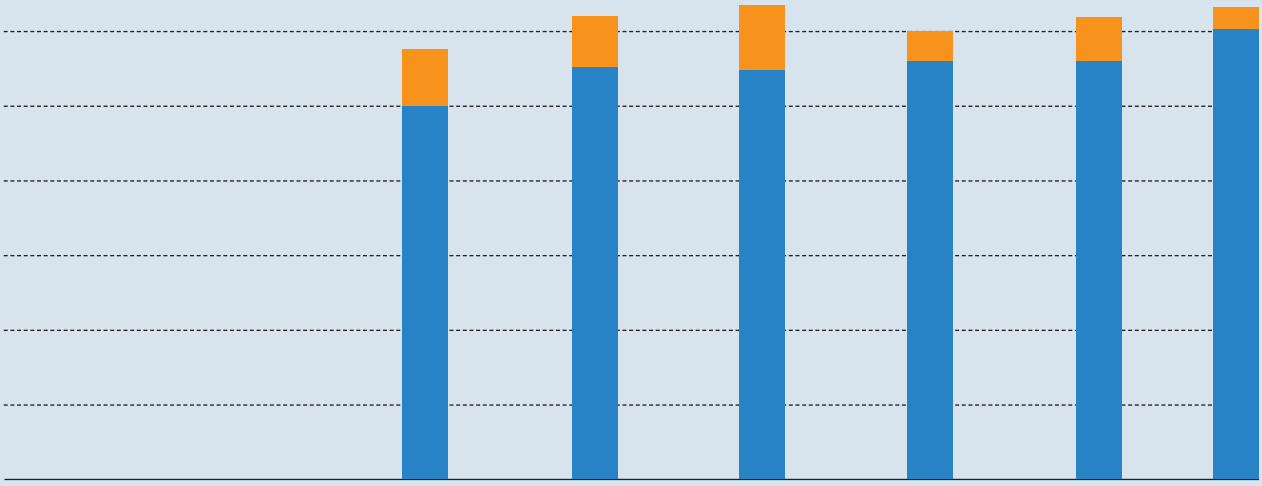
BUSINESS DEVELOPMENT

Financial Volume

The Fraunhofer IPT can look back on a successful business year 2018. The financial volume increased by 2.3 percent year-on-year to 31.5 million euros euros. Project revenues with a total volume of 21.9 million euros covered a major proportion of the Fraunhofer IPT's operating costs.

We shall provide a more detailed description of the recent financial developments underneath. The financial volume is a figure from the Fraunhofer-Gesellschaft's cost-and-performance accounting system, which has been aligned with the requirements of our funding organziations. It reflects both the operating budget (personnel and material expenses) and the actual expenses for investments at the time of their acquisition. The Fraunhofer accountancy system does not adjust these figures for depreciations. Investments in 2018 accounted for a much smaller proportion of the financial volume than in the previous year. The Fraunhofer IPT disclosed investments of only 1.5 million euros in 2018, approx. 52 percent of the previous year's level, largely a consequence of delays in its construction projects.

Financial volume of the Fraunhofer IPT in euros



	2013	2014	2015	2016	2017	2018
Financial volume	**28,7**	**30,9**	**31,6**	**29,9**	**30,8**	**31,5**
Operating budget	24,9	27,5	27,3	27,9	27,9	30,0
including personnel expenses	14,3	15,5	16,0	16,4	16,7	17,6
including material expenses	9,0	10,5	9,7	9,8	9,6	10,7
Investment	3,8	3,4	4,3	2,0	2,9	1,5

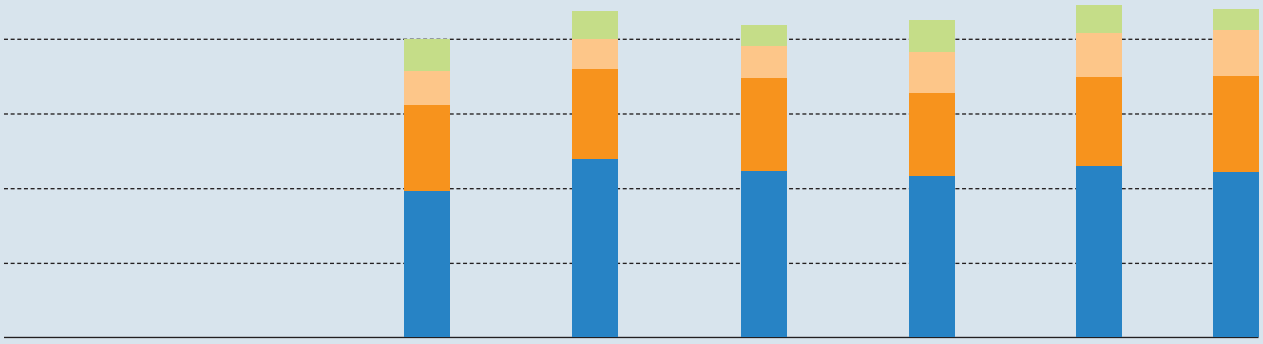
Personnel expenses in the operating budget increased by 5.4 percent to 17.6 million euros, reflecting – among other factors – an increase in the headcount (17 new members of staff or 3.7 percent of the total workforce). Material expenses in 2018 (10.7 million euros) were 11.5 percent higher than for the previous year.

Contract Research

Contract research accounted for approx. 73 percent of the Fraunhofer IPT's financial volume. It represents the Institute's core business which includes contract research projects for clients in manufacturing and the service industries, government-sponsored research projects and prospective research that receives some basic external funding, all reflecting the commitments in the mission statement of the Fraunhofer-Gesellschaft. The Fraunhofer-Gesellschaft receives its basic funding from the German Federal Ministry of Education and Research and the federal state governments in a proportion of 90 : 10.

The total volume of the 2018 budget increased by 2.3 percent year-on-year to 31.5 million euros. This amount includes the operating budget of 30 million euros (+ 2.0 percent) and investment expenses of 1.5 million euros, 48.3 percent below the previous year's figure. In line with the Fraunhofer model, two thirds of the budget were funded from project revenues which, at a total volume of 21.9 million euros, were slightly lower than for the previous year. By increasing both its revenues from

Fraunhofer IPT contract research in million euros



	2013	2014	2015	2016	2017	2018
Total project revenue	**20,0**	**21,8**	**20,9**	**21,2**	**22,2**	**21,9**
incl. corporate	9,7	11,9	11,1	10,7	11,4	11,0
incl. government funds	5,8	6,0	6,2	5,6	6,0	6,4
incl. EU funds	2,3	2,0	2,2	2,7	2,9	3,1
incl. other	2,2	1,9	1,4	2,2	1,9	1,4

contract research and its public research subsidies, however, the Fraunhofer IPT still managed to generate a slightly increased overall income.

Contributions of Project Revenues to the Total Income

Corporate revenues fell slightly (by 3.5 percent) to 11 million euros, while revenues from federal and state subsidies increased (by 6.7 percent) to 6.4 million euros and EU subsidies increased (by 6.7 percent) to 3.1 million euros. Other revenues fell by 26 percent to 1.4 million euros.

The Fraunhofer IPT therefore complied with the Fraunhofer model which obliges all institutes to acquire more than two thirds of their budgets on the open market.

This is why the proportion of project revenues and – specifically – corporate revenues to the total volume of the operating budget are important benchmarks. In 2018, project revenues accounted for 73 percent of the operating budget, corporate revenues for 37 percent. Government subsidies for the Fraunhofer IPT's projects (funds from federal as well as state governments) accounted for 29 percent, EU subsidies for 0.2 percent and other income for 1.4 percent. The long-term trends in the development of these proportions confirm the extraordinary levels of success that the Fraunhofer IPT has achieved by its efforts in the contract research and research project business.

Parameters: Development of the Fraunhofer IPT 2018 in million euros

	2017	2018		Change
Financial volume	**30,8**	**31,5**	**+0,7**	**+2,3 %**
Operating budget	27,9	30	+2,1	+5 %
incl. personnel expenses	16,7	17,6	+0,9	+5,4 %
incl. material expenses	9,6	10,7	+1,1	+11,5 %
Investment expenses	2,9	1,5	-1,4	-48,3 %
Project revenues	**22,2**	**21,9**	**-0,3**	**-1,4 %**
Contract research	22,2	21,9	-0,3	-1,4 %
incl. commercial revenues	11,4	11	-0,4	-3,5 %
incl. government subsidies	10,8	10,9	+0,1	+0,9 %
Headcount	454	471	+17	+3,7 %

JOBS AND EQUAL OPPORTUNITIES

Members of Staff

At the end of 2018, the Fraunhofer IPT employed a total of 471 people. This figure included 128 regular members of staff in science, technology and administration as well as 238 high-school as well as university students and ten apprentices. The IPT hired 17 new employees in 2018, another year-on-year increase of its headcount (+3.7 percent). Members of the Fraunhofer-Gesellschaft – and the Fraunhofer IPT specifically – always aim to provide their staff with opportunities for professional and personal development, enabling them to confidently apply for positions of responsibility in universities, businesses or within the structures of the Fraunhofer Society. This approach which is deeply rooted in the principles of the Fraunhofer-Gesellschaft and of the Fraunhofer IPT shows that a first job at the Fraunhofer IPT can provide most of the young researchers at the Institute with an important stepping stone for their careers in science and academia. The Fraunhofer IPT identifies and fast-tracks talented young people, helping them in their first steps towards executive careers or – in certain areas – towards careers in applied science, for example by enabling them to participate in the Fraunhofer trainee scheme for "Fraunhofer Research Managers".

In keeping with the knowledge transfer concept of the Fraunhofer-Gesellschaft – the dissemination of technological know-how through individual scientists – the Fraunhofer IPT encourages its employees to use their jobs at the Institute as a springboard, enabling them to compete for various top jobs in industrial manufacturing or to establish spin-offs. The high level of fluctuation within the workforce of the IPT research departments is therefore a positive sign.

In 2018, 30 researchers left the Fraunhofer IPT and twelve finished their temporary contracts by completing their doctoral degrees while 25 new members of staff were recruited, the majority of whom (88 percent) were young scientists in their first jobs.

At the end of the year, the Fraunhofer IPT employed 128 scientists, who accounted for 57 percent of the entire personnel in the research, technology and administration departments. Vocational training is also an integral element of the Fraunhofer IPT's staff policies. In 2018, the Institute employed a total of ten apprentices, providing them with professional skills in the areas of IT systems integration and office management as well as academic knowledge under the principles of the dual occupational training system.

Equal Opportunities

The imperative to provide equal career opportunities for men and women is deeply ingrained in the organizational structures and the culture of the Fraunhofer IPT. The Fraunhofer IPT supports the reconciliation of careers and private or family lives and provides its employees with options that include flexible working hours, Home Office work and part-time employment. The Fraunhofer IPT has also established a parent-and-child office to meet special individual demands for child care facilities. Beyond that, the admin staff of the Fraunhofer IPT are always looking forward to helping young parents in their search for nursery places and emergency or holiday child care facilities. We also help our workforce to meet specific health care targets, offering subsidized sports lessons and free office supplies of fruit and mineral water.

It is a stated objective of the Fraunhofer IPT to attract more women to the field of applied engineering research. The Fraunhofer talent development scheme TALENTA provides our female staff members with a wide range of options for acquiring further qualifications within a two-year course program and with opportunities of networking with other women in the Fraunhofer-Gesellschaft. We aim to provide female candidates with systematic support on their paths to academic qualifications and management careers. In 2018, the Fraunhofer IPT's talent development scheme helped one more young woman to realize her ambitions.

NETWORKS AND JOINT VENTURES

Our membership in networks and cooperative projects gives us the ability to solve interdisciplinary problems that would otherwise be beyond the scope of a single institute. The extensive research spectrum covered by the Fraunhofer-Gesellschaft and the proximity to the RWTH Aachen University gives us access to a far greater pool of knowledge to draw from.

Close cooperation with the Laboratory for Machine Tools and Production Engineering WZL of the RWTH Aachen University

In our hometown of Aachen, we closely cooperate in all our areas of activity with the Laboratory for Machine Tools and Production Engineering WZL of the RWTH Aachen University, and our administrative structures are interwoven with those of the Technical University: four fully tenured professors from the RWTH Aachen University also make up the Fraunhofer IPT's Board of Directors. The name of the WZL has for decades been globally synonymous for successful and groundbreaking research as well as innovative ideas in the field of production technology. The WZL conducts basic as well as commercially driven research projects (which are aligned with the requirements of the manufacturing industry) in six departments and develops practice-oriented solutions for lean and efficient production lines.

Cooperation in the Fraunhofer Group for Production

The Fraunhofer IPT is a member of the Fraunhofer-Gesellschaft's Group for Production. This Group comprises eleven Fraunhofer Institutes and other bodies which have decided to pool their resources to conduct joint production-oriented research and development projects. By uniting the different skill sets and experiences of the individual institutes, the Group is capable of providing clients with a broad portfolio of research and development services and of addressing virtually all production issues of a modern company – including the challenges of Industry 4.0, the potential of additive manufacturing, Big Data and new technologies such as Artificial Intelligence and biological transformation.

Fraunhofer Alliances

The Fraunhofer IPT also participates in a number of Fraunhofer Alliances:

- The Fraunhofer Automobile Production Alliance
- The Fraunhofer Big Data Alliance
- The Fraunhofer Additive Manufacturing Alliance
- The Fraunhofer Lightweight Design Alliance
- The Fraunhofer Vision Alliance

All Alliances aim to coordinate their efforts of exploring certain research areas as well as their marketing activities.

On the RWTH Aachen Campus

Eleven dedicated research clusters are currently being developed on the RWTH Aachen Campus at Melaten. The Fraunhofer IPT is providing this project with technical and personal assistance. The clusters are intended as a platform for manufacturers and research institutions to pool resources, to create synergies and to exchange their findings. This close cooperation will reduce friction losses in alignment processes, accelerate the speed of the scientific progress and improve the quality of the research activities. It will also help to reduce the costs of research and development. The Fraunhofer IPT is cooperating particularly closely with the clusters for production technology, photonics and smart logistics.

INTERNATIONAL COOPERATION

The Fraunhofer IPT also contributes to research projects outside of Germany, cooperating with foreign universities and research institutions to run Project Centres in Sweden, Ireland, the Netherlands and the USA. The plan is to use these joint ventures for the partners' mutual benefit, improving technological skills and scientific knowledge while serving international markets with greater efficiency.

"Powertrain Manufacturing for Heavy Vehicles Application Lab" in Stockholm

Two years ago, a consortium of powertrain manufacturers and research institutions was established in Sweden with a view to strengthening and securing the competitiveness of its industrial members. The Powertrain Manufacturing for Heavy Vehicles Application Lab was established on 13 September 2016 by the Fraunhofer IPT, the Royal Institute of Technology in Stockholm, the Swerea KIMAB and Swerea IVF research institutes (members of the research network RISE – Research Institutes of Sweden), the Technical University of Chalmers and the industrial manufacturers Scania, Volvo Trucks and Sandvik. Through the projects of the new centre, the partners will develop technologies for the mass production of components in the powertrains of heavy-duty vehicles and improve conventional production processes.

Fraunhofer Project Centre for Design and Production Engineering for Complex High-Tech Systems at the University of Twente

In January 2017, the Fraunhofer-Gesellschaft opened the Fraunhofer Project Center (FPC) on the campus of the University of Twente. The FPC is a joint venture of the Fraunhofer IPT, the University of Twente and the Saxion University of Applied Sciences in Enschede. These three institutions aim to accelerate the cross-border development of complex and sophisticated technologies for Industrie 4.0 in Germany as well as the Netherlands. The joint venture is designed to strengthen the competitive position of all partners, supporting the market-oriented development of "smart industries" on both sides of the Dutch-German border.

Centre for Embedded Bioanalytical Solutions in Dublin

In May 2017, the Fraunhofer-Gesellschaft opened its first Fraunhofer Project Centre in Ireland, a joint venture of the Fraunhofer IPT and Dublin City University (DCU). The FPC@DCU intends to combine the two partners' skills and experience in the development of micro-fluidic lab-on-a-chip systems that are employed for applications in medicine, the pharmaceutical industry, production and analytics. The Science Foundation Ireland and Fraunhofer support the project with an amount of EUR 2.5 million euros each for a period of five years. The Fraunhofer IPT hopes to use the joint venture as a means of gaining access to potential clients from the medical technology industry (which is very strong in Ireland), while our Irish partners welcome the opportunity of establishing contacts and networks within the international research community of the Fraunhofer-Gesellschaft.

Fraunhofer Center for Manufacturing Innovation CMI in Boston

For many years, the Fraunhofer Center for Manufacturing Innovation CMI has been closely cooperating with the Fraunhofer IPT in many areas of research. Together with Boston University, the Fraunhofer CMI has developed production technology solutions for various industries ranging from biotechnology and biomedicine and photonics to renewable energies. Their joint research has focused on high-precision automation systems for high-tech applications and medical technology equipment. Their close partnership allows both Fraunhofer IPT and CMI to offer foreign clients production technology research and development services at their own production sites while providing a bridge for mutually beneficial technology transfers between European and US-based manufacturers.

COMMUNITIES

International Center for Networked Adaptive Production ICNAP

On 12 and 13 December 2018, the International Center for Networked Adaptive Production (ICNAP) convened its members for its first annual assembly in Aachen to determine its research and development priorities for the coming year. ICNAP aims to establish itself as a leading research community for new digitalization and networking production technologies by first designing and then developing new Industrie 4.0 production systems and value chains to the point where they can be integrated into industrial manufacturing lines. It was for this purpose that the ICNAP was formally established at the Hannover Messe in April 2018 by the Fraunhofer Institutes IPT, ILT and IME as well as renowned manufacturers from a wide range of industries including metrology and sensorics, IT, heavy engineering and systems engineering. Participants of the moderated research community will have access to the test and research data that will be made available within the community. ICNAP members will also be allowed to run their own applications through the community's comprehensively networked pool of sophisticated equipment that features top-of-the-range sensorics as well as 5G data transmission facilities and that is integrated into the "Virtual Fort Knox" Fraunhofer Cloud. All of this equipment can be used in the context of joint as well as bilateral research and development projects.

The ICNAP was originally established in late 2016 as the Fraunhofer High Performance Center Networked Adaptive Production. Based on an initiative of the state government of North-Rhine-Westphalia and the Fraunhofer-Gesellschaft, it received massive support from the industry and operated on an initial budget of 6.4 million euros. The ICNAP has been designed to operate as an institutional framework that sustains the activities of the partners in the High Performance Center and remains open for other companies that want to join.

International Center for Turbomachinery Manufacturing ICTM

The International Center for Turbomachinery ICTM was established at Aachen through a joint initiative of the Fraunhofer IPT, the Fraunhofer ILT and the WZL oft the RWTH Aachen University as well as the Institute for Additive Production (DAP) of the RWTH Aachen University. The ICTM's activities reflect the entire range of technologies that is covered by the four founding members and aim to provide the turbomachinery manufacturing and maintenance industry with top-of-the-range research and development services. The ICTM was established in close cooperation with partners from the industry and is designed to accelerate the implementation of technological innovations and their integration into industrial production lines.

INC Invention Center

The Invention Center on the RWTH Aachen Campus is a place where the technical university's partners can acquire further qualifications in technology and innovation management and strive to find perfect solutions for their manufacturing challenges. In coordination with TIME Research Area, the Fraunhofer IPT, the WZL of the RWTH Aachen University and KEX Knowledge Exchange AG, the INC Invention Center has developed INCworX, a creative space designed to provide people who are responsible for future planning and current decision-making processes in the industry with an inspiring environment for the various stages of the innovation process, from the development of initial ideas to the series production of products for commercial distribution.

OUTLOOK

Digitalization and Networking

The Fraunhofer IPT is expecting a further consolidation of its digitalization and networking initiatives in 2019. Following the 2018 launch of the "Virtual Fort Knox" Fraunhofer Cloud and the opening of the 5G facilities in the machine hall, we are looking forward to building on these foundations by welcoming more partners from business and industry to the ICNAP community and by extending the connectivity of our plants and equipment beyond the physical confines of the Institute.
For this purpose, the Fraunhofer IPT – in close cooperation with its partners at the RWTH Aachen Campus and the mobile network provider Ericsson – developed the concept of the 5G-Industry Campus Europe. This 5G research network has been designed to provide the Fraunhofer IPT and its partners with a platform for joint research and trial studies into potential industrial applications for new wireless communication strategies.

Sustainable Energy Consumption and Mobility

Another priority of the Fraunhofer IPT is the continuous alignment of its production technology know-how with the requirements of Germany's drive towards a sustainable energy management. By focusing on the "Future Powertrain" project and by consistently continuing existing projects to manufacture and maintain more energy-efficient turbo engines for the aviation and energy generation industries, the Fraunhofer IPT is making its own contribution to a reduction of CO_2 emissions and the compliance with international climate targets. In order to ensure levels of individual mobility and logistic efficiency that meet the needs of the general population, manufacturers will need to provide affordable electric car engines, energy storage systems and propulsion systems made from recyclable materials that use few resources and produce few emissions. This is a challenge to which the Fraunhofer IPT and its industrial partners will dedicate an increasing number of research and development projects over the coming years.

In 2019, the Fraunhofer IPT and its partners in North-Rhine-Westphalia will launch their agenda by researching fuel cell production and by developing a comprehensive and scalable value chain for such cells before recruiting other research institutions for a long-term initiative designed to integrate the project into a sustainable research infrastructure.

Building the new facilites

The home of the Fraunhofer IPT in Aachen will experience a wide range of building activities throughout the new year which had originally been planned for the summer of 2018 but had to be delayed several times for a number of technical reasons. The market for building works and improvements is currently very tight and difficult to manage for public clients, but we are confident that the first stage of the works to renovate the lobby and the lecture hall as well as the front of the old building will finally start in May 2019. Our members of staff will undergo a number of inconveniences once the works on the outer walls and the windows are under way, but we hope that, by providing temporary offices as well as generous flexible working time and home office arrangements, we shall be able to come up with a viable solution. We only hope that the building works will now proceed smoothly and on time, which would allow us to update the AV equipment of the lecture hall and to complete our new lobby area in the summer of 2020.

The Board of Directors would like to thank all partners, customers and suppliers for their continuous support. Our special gratitude is owed to the employees of the Fraunhofer IPT whose untiring commitment, engagement and professionalism have provided the foundation for another successful year in the annals of our Institute.

Fraunhofer Institute for Production Technology IPT, Aachen

Prof. Dr.-Ing. Christian Brecher, Prof. Dr.-Ing. Thomas Bergs, Prof. Dr.-Ing. Robert Schmitt, Prof. Dr.-Ing. Günther Schuh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Modul 2: Analysing

STRATEGIC INITIATIVES

Cluster of Excellence „Internet of Production"

The Cluster of Excellence "Internet of Production"" Cluster of Excellence received a positive evaluation in September 2018 when it succeeded the Cluster of Excellence for "Integrative Production Technology in High-Wage Countries". This means that it has taken its place as one of the RWTH Aachen University's three Clusters of Excellence and will receive funding under the federal and state governments' Strategy of Excellence for at least seven years. Professor Christian Brecher in his capacity as the Director of the Chair for Machine Tools at the WZL of the RWTH Aachen University acts as the Speaker of the Cluster.

The Cluster has been designed to develop application-oriented solutions for the upgrading of production technology in line with the requirements of the 4th industrial revolution. The Internet of Production, the heartpiece of Industrie 4.0, ensures the secure availability of information and relevant data anytime and anywhere, paving the way into a new era of manufacturing. Reliable prognoses will allow a consistent control of the production process on the basis of huge amounts of aggregated data. Information will be collected and circulated across all internal corporate divisions, from the product design stage to the quick and smooth implementation of changes in the series production process. This approach of demand-driven data analyses and the use of machine learning algorithms has a huge potential and will have an enormous impact on tomorrow's production technology.

The Cluster of Excellence combines the skills and experiences of more than 25 research institutions in fields such as production technology, IT, materials science and economics as well as ergonomics and psychology. These institutions are combining their efforts to meet the interdisciplinary challenge of implementing the Internet of Production.

High-Performance Center for Networked Adaptive Production

The High-Performance Centre Networked Adaptive Production focuses on the development, the systematic implementation and the use of innovative digitalization technologies for sustainable industrial production lines and value chains of Industry 4.0. At the Center, the three Aachen-based Fraunhofer Institutes IPT, ILT and IME develop solutions for the fields of energy, mobility and healthcare in six pilot lines with a view to digitalizing and integrating production lines and systems into comprehensive networks before validating their newly developed solutions in representative process chains. The High-Performance Center aims to use the first research stage of three years for the development of an open research platform and industrial test environment in which new concepts for a digitalized production system can be designed and tested under realistically simulated conditions.

On 12 and 13 December 2018, the International Center for Networked, Adaptive Production (ICNAP), a research community for new concepts in digitalized and networked production that was a direct spin-off from the High-Performance Center's activities, convened its members for its first annual assembly in Aachen. Participants of the moderated research community will have access to the test and research data that will be made available within the community. ICNAP members will also be allowed to run their own applications through the community's comprehensively networked pool of sophisticated equipment that features top-of-the-range sensorics as well as 5G data transmission facilities and that is integrated into the "Virtual Fort Knox" Fraunhofer Cloud. All of this equipment can be used in the context of joint as well as bilateral research and development projects. On Day 2 of the annual meeting, the participants decided to launch three joint studies to conduct practical research in the areas "Digital Twins", "5G" and "Middleware for the Industrial Internet of Things".

5G

Due to its short latencies (of under one millisecond), high data transmission rates (up to 10,000 Mb/s) and the option of simultaneously operating a large number of devices in narrowly confined radio cells, 5G technology provides the ideal fit for networked adaptive production lines. After all, the operation of high-precision machine tools that feature sophisticated measuring technology and control instruments for complex manufacturing processes requires stable and reliable communication links. This is why the Fraunhofer IPT and the Swedish technology provider Ericsson have decided to coordinate their research into the development of 5G-assisted production scenarios before running their industrial designs jointly through trials in realistic production environments.

The use of 5G technology will, for the first time, enable the use of wireless sensor connections for real time data analyses and an adaptive control of manufacturing processes with short response times. The Fraunhofer IPT is testing 5G-assisted production processes and is planning to integrate 5G technology comprehensively into a range of applications within the High-Performance Center, linking machines as well as production and communication systems with extensive databases.

Future Powertrain

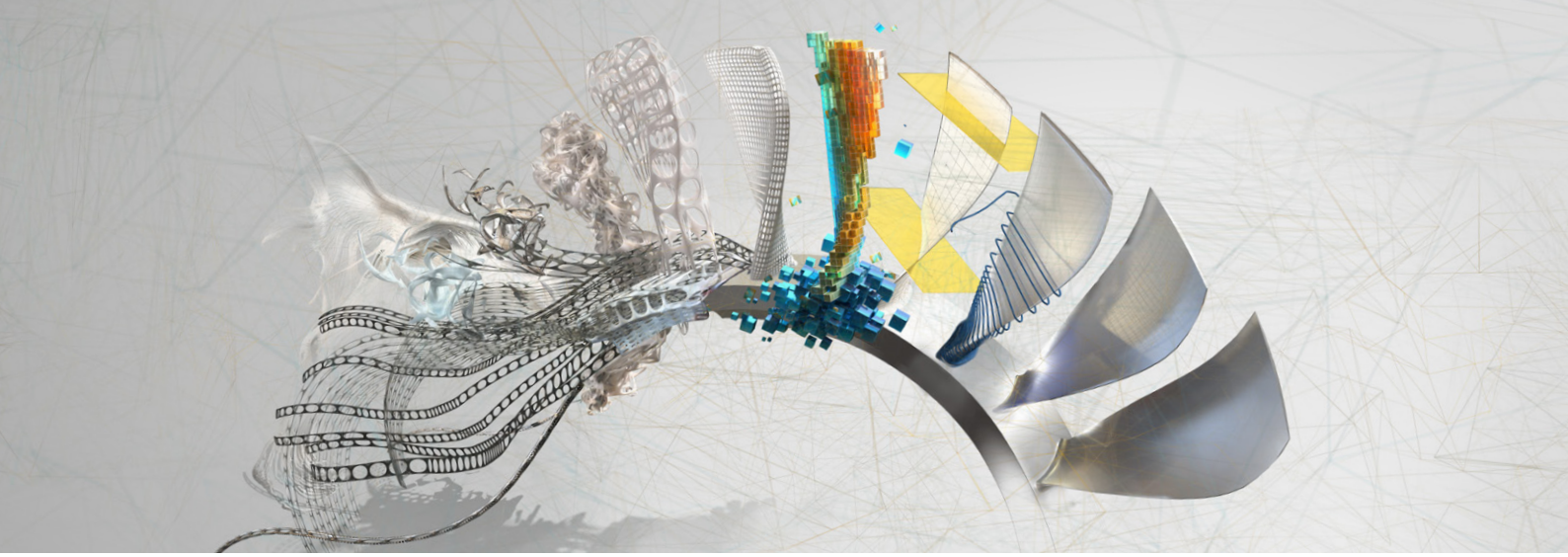
The market for electric cars is growing in Europe and all over the world. This is why the Fraunhofer IPT is currently focusing its skills and competences across the entire range of production technologies on the production of components for the electric powertrain – from conventional lithium-ion batteries to fuel cells.

Hydrogen has been identified as a key candidate for the storage of renewable energies in future mobility applications. While lithium-ion technology continues to represent the most sensible solution for many of today's applications, the low energy content and long recharging periods of these batteries appears to prevent a dramatic breakthrough of electromobility in many areas (such as commercial vehicles) for the foreseeable future. Physical laws restrict the batteries' storage capacity, and their sheer weight in conjunction with the long recharging periods render them unfit for many applications.

No manufacturer anywhere in the world, meanwhile, has succeeded in overcoming the challenges of producing fuel cells on an industrial scale and at commercially viable costs. This is why the Fraunhofer IPT and its industrial partners in North-Rhine-Westphalia are working to develop an infrastructure for the low-cost production of fuel cells and to explore the route to an integrated value chain for the development of hydrogen-based mobility concepts.

Initial research projects of the Fraunhofer IPT have indicated that hydrogen storage tanks made from wound fiber composites may provide the solution to one part of the problem. Before such tanks can be produced in large series, however, manufacturing costs must be reduced so that the production of fuel cell technology can be scaled up and become competitive.

Laser-assisted tape winding technology enables the automated and flexible manufacturing of fiber-composite pressure tanks that are suitable for the safe as well as efficient storage and transport of gaseous fuel in automobiles. This is why the EU project "ambliFibre" focused on the optimization of processes and machinery for the technology of laser-assisted tape winding. Coordinated by the Fraunhofer IPT, an international corporate consortium has been developing new mechanical and software modules to increase the reliability of the processes in order to improve their chances on the open market.



The current aim of the consortium is to conduct new research and development studies with the WZL of the RWTH Aachen University, industrial partners and international project centres such as the PMH at the KTH Stockholm and to integrate the results of these studies into prototype mass production lines for the powertrains of the future, laying the foundations for a preservation of Germany's status as a competitive operating site for high-tech car manufacturers.

EVOLOPRO lighthouse project

The Fraunhofer lighthouse project "EVOLOPRO" aims to develop a so-called biological manufacturing system, complementing existing Industrie 4.0 research of the Fraunhofer-Gesellschaft with new insights in the high-priority field of biological transformation and into biological mechanisms.

The seven participating Fraunhofer Institutes intend to pave the way for the development of a new generation of production systems that actively exploit mechanisms of evolutionary biology. These Biological Manufacturing Systems (BMS) will be designed to adapt autonomously to newly emerging requirements and environments, very much like biological organisms – with the main difference that these processes of adaptation will not require thousands of years but much shorter periods of time. One key principle is that manufacturing errors will no longer be seen as waste but – in an analogy to the evolution of biological organisms – as a valuable resource for the process of adaptation and development.

This form of evolution will not only be based on new algorithms that imitate natural processes but also on the creation of digital twins that interact with their digital environment. Following the "survival of the fittest" principle, any differences between the target component and the actual component will already be assessed and evaluated at the digital state of the production process. The validation of the results will be performed through the use of demonstrators in three pilot applications: one for an individual component, one for the assembly of several individual components and one for a temporary interaction of several individual components.

Since such biological manufacturing systems can assume very high levels of complexity, other institutions have been requested by the project coordinators of the Fraunhofer IPT to contribute their specific skills and competences to the challenging tasks in production technology, materials technology and IT. EVOLOPRO was one of three projects to receive approval (out of 18 applications) and will now be funded within the Fraunhofer-Gesellschaft for a period of four years (starting in January 2019), receiving a total of 8 million euros.

ONGOING AND RECENTLY COMPLETED PROJECTS (SELECTION)

European Commission

ADALAM – Sensor based adaptive laser micromachining using ultrashort pulse lasers for zero-failure manufacturing
Lifetime: 1/2015 bis 6/2018
Total funding: 432 256 €
Program: Horizon 2020
Subsidy ref. no.: 637045

ambliFibre – Adaptive model-based Control for laser-assisted fibre-reinforced tape winding
Lifetime: 9/2015 bis 8/2018
Total funding: 851 117 €
Program: Horizon 2020
Subsidy ref. no.: 678875

AUTOSTEM – An automated production line for large-scale stem cell production
Lifetime: 1/2016 bis 12/2018
Total funding: 1,2 Mio €
Program: Horizon 2020
Subsidy ref. no.: 667932

ComMUnion – Net-shape joining technology to manufacture 3D multi-materials components based on metal alloys and thermoplastic composites
Lifetime: 12/2015 bis 5/2019
Total funding: 468 343 €
Program: Horizon 2020
Subsidy ref. no.: 680567

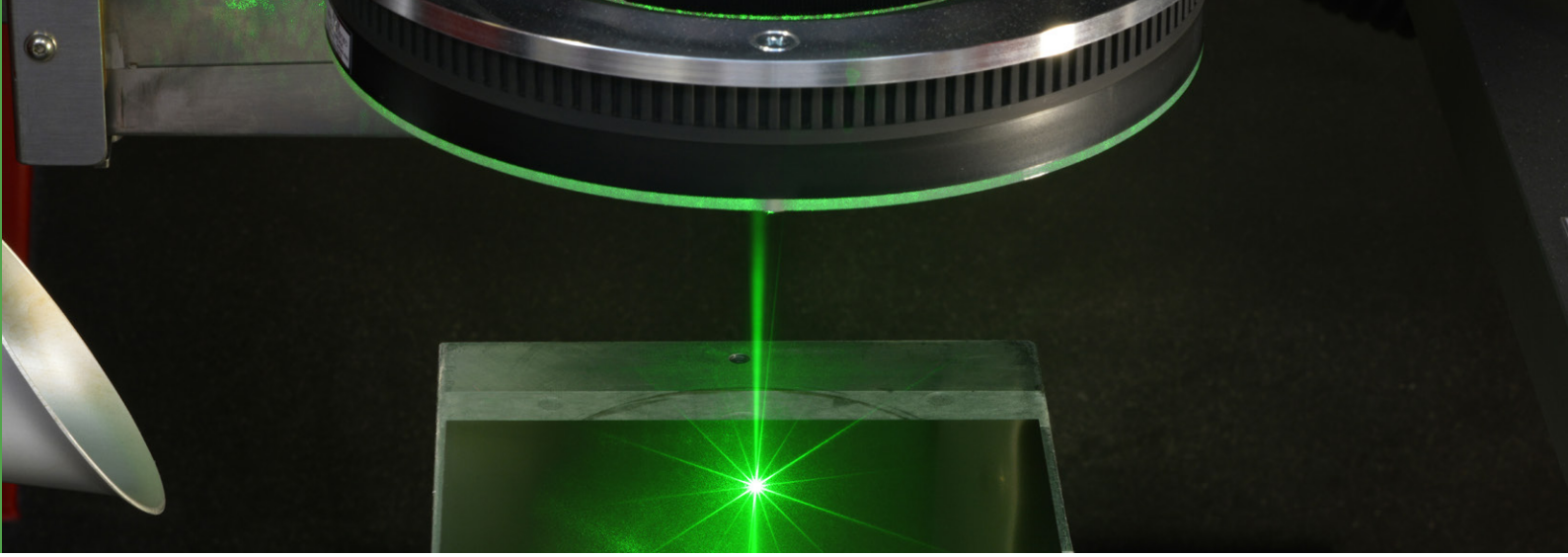
EPIC – Centre of Excellence in Production Informatics and Control
Lifetime: 4/2017 bis 03/2024
Total funding: 1,088 Mio €
Program: Horizon 2020
Subsidy ref. no.: 739592

ESSIAL – Electrical Steel Structuring, Insulating and Assembling by means of the Laser technologies
Lifetime: 11/2017 bis 10/2021
Total funding: 325 508 €
Program: Horizon 2020
Subsidy ref. no.: 766437

FLEXPOL – Antimicrobial flexible polymers for its use in hospital environments
Lifetime: 1/2017 bis 12/2019
Total funding: 1,076 Mio €
Program: Horizon 2020
Subsidy ref. no.: 721062

LiNaBioFluid – Laser-induced Nanostructures as Biomimetic Model of Fluid Transport in the Integument of Animals
Lifetime: 7/2015 bis 6/2018
Total funding: 484 096 €
Program: Horizon 2020
Subsidy ref. no.: 665337

Mirphab – Midinfrared Photonics devices fabrication for chemical sensing and spectroscopic applications
Lifetime: 1/2016 bis 12/2019
Total funding: 119 915 €
Program: Horizon 2020
Subsidy ref. no.: 688265



OpenHybrid – Developing a novel hybrid AM approach which will offer unrivalled flexibility, part quality and productivity
Lifetime: 10/2016 bis 9/2019
Total funding: 525 113 €
Program: Horizon 2020
Subsidy ref. no.: 723917

Openmind – On-demand production of entirely customised minimally invasive medical devices
Lifetime: 9/2015 bis 8/2018
Total funding: 769 246 €
Program: Horizon 2020
Subsidy ref. no.: 680820

PoLaRoll – Polygon scanner based ultra-short pulse laser processing in roll-to-roll manufacturing
Lifetime: 10/2016 bis 9/2019
Total funding: 1,260 Mio €
Program: Horizon 2020
Subsidy ref. no.: 723805

SERENA – Versatile plug-and-play platform enabling remote predictive maintenance
Lifetime: 10/2017 bis 9/2020
Total funding: 404 681 €
Program: Horizon 2020
Subsidy ref. no.: 767561

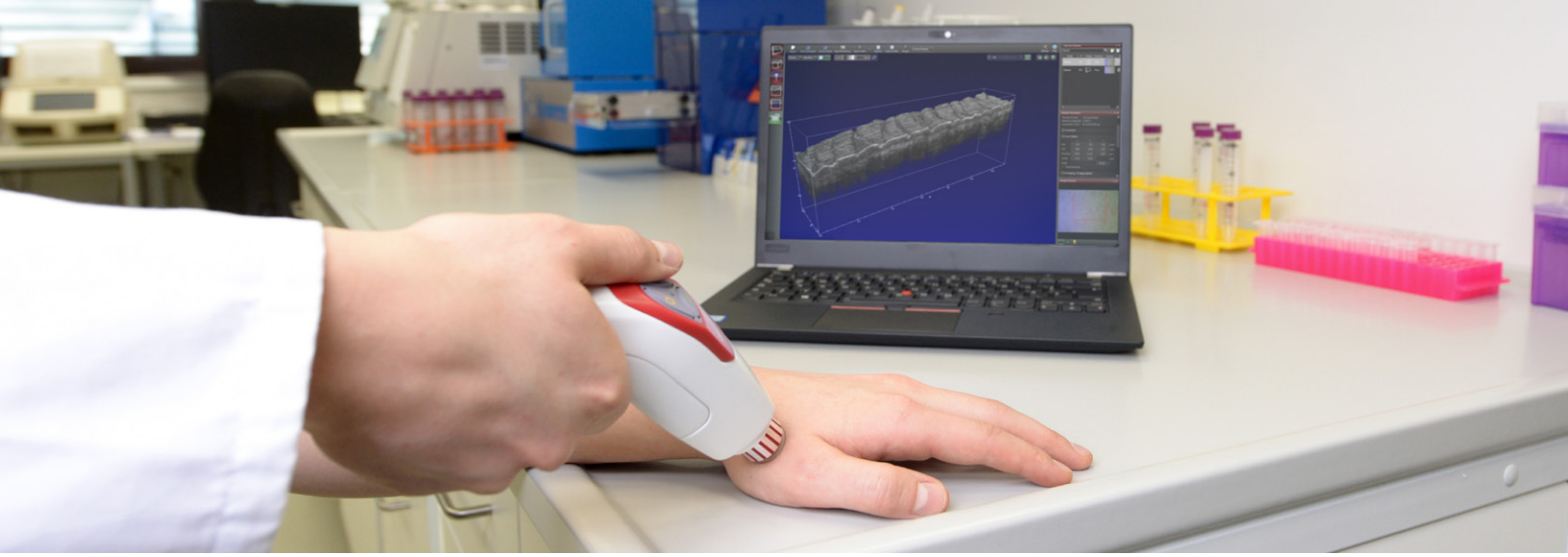
Symplexity – Symbiotic Human-Robot Solutions for Complex Surface Finishing Operations
Lifetime: 1/2015 bis 12/2018
Total funding: 714 875 €
Program: Horizon 2020
Subsidy ref. no.: 637080

TopCladd – Adaptive Laser Cladding for Precise Metal Coating Based on Inline Topography Characterization
Lifetime: 9/2017 bis 8/2019
Total funding: 424 686 €
Program: M-ERA.Net – flexible und bedarfsgerechte transnationale Förderung im Bereich der Materialforschung
Subsidy ref. no.: 13N14265

German Federal Ministry of Education and Research (BMBF)

eMES – Entwicklung eines Prototyps zur energie-orientierten Produktionssteuerung sowie Maschinensteuerung und -überwachung zur Integration in ein Manufacturing Execution System
Lifetime: 10/2014 bis 8/2017
Total funding: 351 620 €
Project management agency: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/DLR-Projektträger
Program: KMU-innovativ: IKT - Software Engineering
Subsidy ref. no.: 01IS14025B

Forschungscampus Digital Photonic Production – Verbundvorhaben: Qualifikation neuartiger Materialien und Geometrien für Optiken zur Steigerung der Leistungsfähigkeit von Strahlführungssystemen (MaGeoOptik DPP)
Lifetime: 12/2014 bis 9/2019
Total funding: 664 830 €
Project management agency: VDI Technologiezentrum GmbH
Program: Förderinitiative Forschungscampus – öffentlich-private Partnerschaft für Innovationen
Subsidy ref. no.: 13N13530



HydroMill – Entwicklung der 5-Achs-Wasser-Abrasivstrahl-Schruppbearbeitung zur effizienten Bearbeitung von Hochleistungswerkstoffen
Lifetime: 8/2014 bis 12/2017
Total funding: 494 600 €
Project management agency: Projektträger Karlsruhe/Karlruher Institut für Technologie (KIT)
Program: Hochleistungsfertigungsverfahren für die Produkte von Morgen
Subsidy ref. no.: 2PN2230

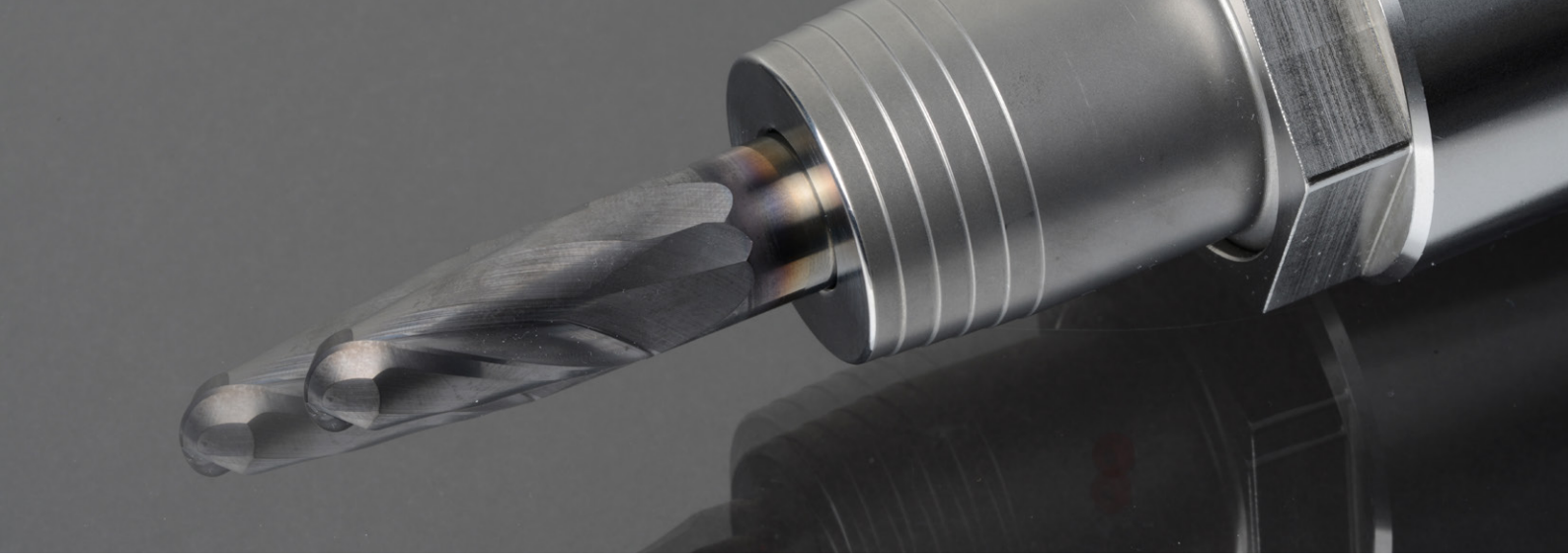
Innovationsforum FOMed – Konzeption und Aufbau eines Innovationsnetzwerks für die Medizin (Forschungsallianz OCT)
Lifetime: 9/2017 bis 5/2018
Total funding: 99 945 €
Project management agency: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/DLR-Projektträger
Program: Innovationsforen Mittelstand
Subsidy ref. no.: 01MI1709

LightFlex – Photonische Prozesskette zur flexiblen, generativen, automatisierten und wirtschaftlichen Herstellung individuell angepasster hybrider Leichtbauteile aus thermoplastischem Faserverbundkunststoff
Lifetime: 5/2015 bis 4/2018
Total funding: 680 000 €
Projektrträger: Forschungszentrum Jülich GmbH (FZJ)/Projektträger Jülich PTJ
Program: Photonische Prozessketten (WING)
Subsidy ref. no.: 03XP0013E

MetalSens – Entwicklung einer Prozesskette zur staubarmen Rückgewinnung von Technologiemetallen bestückter Leiterplatten mittels sensorgestützter Sortierung
Lifetime: 9/2016 bis 8/2019
Total funding: 412 160 €
Project management agency: Projektträger Jülich (PTJ)/ Forschungszentrum Jülich GmbH (FZJ)
Program: r4 – Forschung zur Bereitstellung wirtschaftsstrategischer Rohstoffe/Ressourceneffizienz
Subsidy ref. no.: 033R 173A

NiTiProstab – Einsatz superelastischer Nickel-Titan-Formgedächtnislegierungen zur Steigerung der dynamischen Prozessstabilität bei der Fräsbearbeitung
Lifetime: 5/2016 bis 9/2018
Total funding: 197 292 €
Project management agency: Projektträger Karlsruhe – Außenstelle Dresden – Karlsruher Institut für Technologoe (KIT)
Program: KMU-innovativ: Produktionsforschung
Subsidy ref. no.: 02P15K643

OCTmapp – Optical Coherence Tomography for New Medical Applications
Lifetime: 8/2017 bis 7/2019
Total funding: 125 275 €
Project management agency: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/DLR-Projektträger
Program: IB-ASIEN
Subsidy ref. no.: 01DR17028



OptiWear – Softwarebasierte Optimierung von NC-Programn zur Minimierung von Werkzeugverschleiß und Reduzierung der Herstellkosten
Lifetime: 7/2017 bis 6/2019
Total funding: 190 248 €
Project management agency: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/DLR-Projektträger
Program: KMU-innovativ: IKT – Software Engineering
Subsidy ref. no.: 01IS17018C

PARSyP – Predictive Analytics for Robust Synchronized Production
Lifetime: 1/2017 bis 6/2019
Total funding: 310 853 €
Project management agency: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/DLR-Projektträger
Program: KMU-innovativ: IKT – Software Engineering
Subsidy ref. no.: 01IS16034A-E

Pinocchio – Steigerung der Prozessstabilität durch ein Werkzeughaltersystem mit adaptiver Werkzeugauskraglänge
Lifetime: 11/2016 bis 3/2019
Total funding: 189 998 €
Project management agency: Projektträger Karlsruhe – Außenstelle Dresden – Karlsruher Institut für Technologie (KIT)
Program: KMU-innovativ: Produktionsforschung
Subsidy ref. no.: 02P16K081

ToolRep – Entwicklung einer innovativen Anlagentechnik zur automatisierten und laserbasierten Reparatur strukturierter Formeinsätze
Lifetime: 11/2015 bis 6/2019
Total funding: 423 298 €
Project management agency: Projektträger Karlsruhe – Außenstelle Dresden – Karlsruher Institut für Technologie (KIT)
Program: »Forschung für die Produktion von morgen« zum Themenfeld Produktionsanlagen für Wachstumsmärkte – intelligent einfach und effizient
Subsidy ref. no.: 02P14A032

German Federal Ministry of EconomicAffairs and Energy (BMWi)

LaserJetDrilling – Entwicklung einer wasserstrahlgeführten Laserbohrtechnologie zur effizienten Erschließung geothermischer Ressourcen
Lifetime: 12/2014 bis 5/2018
Total funding: 1,024 Mio €
Project management agency: Forschungszentrum Jülich GmbH (FZJ)/Projektträger Jülich – Erneuerbare Energien (EEN)
Program: Forschungsförderung 6. Energieforschungsprogramm – Erneuerbare Energien
Subsidy ref. no.: 0325784A

CaliBend – Entwicklung und Erprobung eines flexiblen, kostengünstigen Laser-Erwärmungsmoduls für KMU im Bereich der Blechbearbeitung zu Biegen von hochfesten Stählen
Lifetime: 4/2018 bis 3/2020
Total funding: 188 297 €
Project management agency: AIF Projekt GmbH
Program: Zentrales Innovationsprogramm Mittelstand (ZIM) Deutschland – Katalonien
Subsidy ref. no.: ZF 4341804US7

Federal state of North-Rhine-Westphalia

FixTronic – Entwicklung eines flexiblen mechatronischen Spannsystems zur Selbstoptimierung eines Fräsprozess durch aktive Schwingungsdämpfung
Lifetime: 7/2016 bis 12/2018
Total funding: 363 544 €
Project management agency: LeitmarktAgentur.NRW – Projektträger Jülich/Forschungszentrum Jülich GmbH
Program: Europäischer Fonds für regionale Entwicklung (EFRE) 2014-2020
Subsidy ref. no.: EFRE-0800283 / MP-1-1-064a

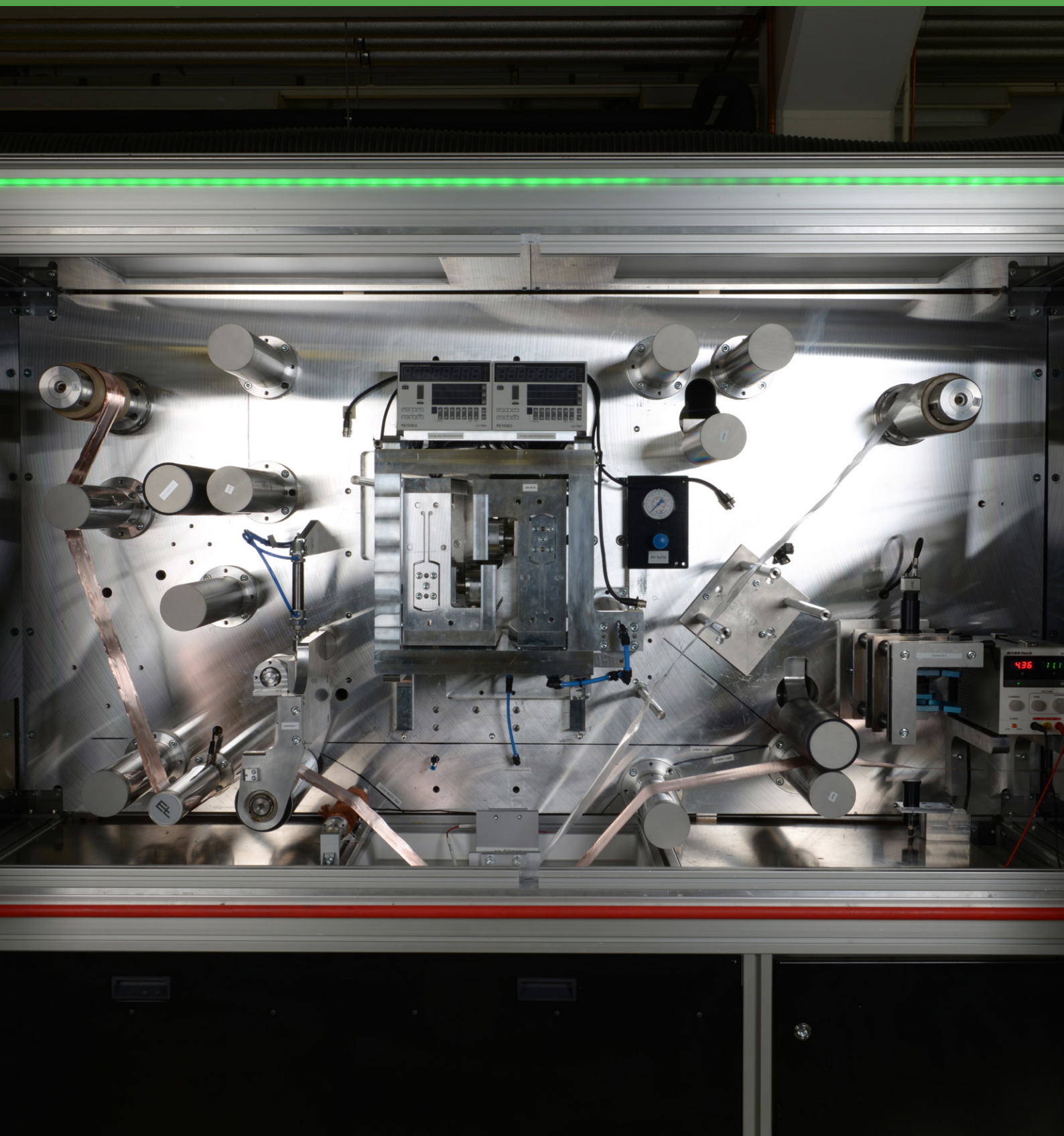
HEA2D – Herstellung, Eigenschaften und Anwendungen von 2D-Nanomaterialien
Lifetime: 4/2016 bis 3/2019
Total funding: 450 811 €
Project management agency: LeitmarktAgentur.NRW – Projektträger Jülich/Forschungszentrum Jülich GmbH
Program: Europäischer Fonds für regionale Entwicklung (EFRE) 2014-2020
Subsidy ref. no.: EFRE-0800150/NW-1-1-036e

RoboTex – Roboterbasierte Lasertexturierung großformatiger Werkzeugformen für den Kunststoffspritzguss
Lifetime: 7/2016 bis 6/2019
Total funding: 621 838 €
Project management agency: LeitmarktAgentur.NRW – Projektträger Jülich/Forschungszentrum Jülich GmbH
Program: Europäischer Fonds für regionale Entwicklung (EFRE) 2014-2020
Subsidy ref. no.: EFRE-0800314 / MP-1-1-055a

Fraunhofer-Leistungszentrum »Vernetzte, adaptive Produktion«
Lifetime: 10/2016 bis 12/2019
Total funding: 984 000 €
Project management agency: Ministerium für Innovation, Wissenschaft und Forschung des Landes NRW
Program: Innovationscluster
Subsidy ref. no.: 423-FhG

DBU – Deutsche Bundesstiftung Umwelt

GreenCoating (GECo) – Substitution umweltbelastender galvanischer Beschichtungsverfahren durch ressourceneffizientes laserunterstütztes Auftragschweißen zur Herstellung elektrischer Kontakte
Lifetime: 5/2018 bis 4/2020
Total funding: 125 000 €
Subsidy ref. no.: 34249/01



PUBLICATIONS

The Fraunhofer IPT has the mission to convert scientific knowledge into economically viable innovations in the field of production technology. This is why we regard scientific papers as an important instrument to demonstrate our capacity to innovate – within the scientific community as well as to potential clients and project partners.

Recent Books

Boos, Wolfgang; Arntz, Kristian; Prümmer, Marcel; Wollbrink, Moritz; Horstkotte, Rainer; Pothen, Mario; Gerretz, Vincent
Erfolgreich CAx-Prozessketten Gestalten im Werkzeugbau
Aachen: WBA, 2018, 38 S.
ISBN 978-3-946612-31-5; ISBN 3-946612-31-8

Boos, Wolfgang; Arntz, Kristian; Johannsen, Lars; Prümmer, Marcel; Horstkotte, Rainer; Ganser, Philipp; Venek, Tommy; Gerretz, Vincent
Erfolgreich Fräsen im Werkzeugbau
Aachen: WBA, 2018, 46 S.
ISBN 978-3-946612-28-5; ISBN 3-946612-28-8

Schuh, Günther; Zeller, Paul
Erfolgsfaktoren im Technologiemanagement: Whitepaper. Empirische Studie
Aachen: Fraunhofer IPT, 2018, 16 S.
ISBN 978-3-00-061760-7
DOI: http://dx.doi.org/10.24406/IPT-N-523956

Vollmer, Thomas; Kerkhoff, Johannes; Große Böckmann, Markus; Permin, Eike
Ressourceneffizienz-Wertstrom: Einfach Ressourcenströme reduzieren
Hrsg.: Robert Schmitt; Fraunhofer IPT, Aachen; WZL der RWTH Aachen
Stuttgart: Fraunhofer Verlag, 2018, 106 S.
ISBN 978-3-8396-1390-0

Patent

Janssen, Henning
Verfahren und Vorrichtung für das Recycling von thermoplastischem Faserverbundmaterial
DE 102016117559 A1: 20160919

A list of all scientific papers that have been published by the Fraunhofer IPT in 2018 can be downloaded via the "Fraunhofer-Publica" bibliography database under the following link:

http://publica.fraunhofer.de/institute/IPT/2018

Doctoral Theses

Bletek, T.: Oberflächenintegrität beim Ultrapräzisionsschleifen transparenter polykristalliner Keramiken. Diss. RWTH Aachen, 2018

Bohne, B.: Entwicklung eines Modells zur Beschreibung der Bewegungsabläufe manueller Polierprozesse auf der Basis der Fraktal-Theorie. Diss. RWTH Aachen, 2018

Brack, A.: Kontinuierliche Herstellung von miniaturisierten Endlosprofilen aus thermoplastischen Faserverbundkunststoffen. Diss. RWTH Aachen, 2018

Driemeyer Wilbert, A.: Automated Zonal Finishing Process Design, Modeling and Optimization. Diss. RWTH Aachen, 2018

Krappig, R.: Hochgenaue wellenfrontbasierte Justage kleinaperturiger optischer Systeme. Diss. RWTH Aachen, 2018

Kreilkamp, H.: Analyse der Einflüsse auf die Gestaltabweichung gepresster Glasoptiken beim nicht-isothermen Blankpressen. Diss. RWTH Aachen, 2018

Lindner, F.: Pragmatic Process Chain Evaluation for Automotive Lightweight Applications. Diss. RWTH Aachen, 2018

Liu, G: Modeling Fracture Behavior in Precision Glass Molding. Diss. RWTH Aachen, 2018

Ottersbach, M.: Belastungsspezifische Werkzeug- und Prozessuslegung für die Schlichtfräsbearbeitung von Hartmetall. Diss. RWTH Aachen, 2018

Ryschka, S.: Strategien für Technologieplattformen in diversifizierten Unternehmen. Diss. RWTH Aachen, 2018

von Mangoldt, J.: Methode zur Ausrichtung der technologiekompetenzbasierten Diversifikation. Diss. RWTH Aachen, 2018

Werner, D.: Fertigung basaltfaserverstärkter Bauteile auf Basis duroplastischer Matrixsysteme mit aktivierbarer Adhäsion. Diss. RWTH Aachen, 2018

MEDIA COVERAGE

Communication and the Media

German media outlets published a total of 266 reports about the Fraunhofer IPT in 2018, an excellent figure which significantly exceeded the average for Institutes within the Fraunhofer-Gesellschaft (191 articles). The Fraunhofer IPT's total reach amounted to 28.4 million media contacts.

These articles were mainly published by non-academic organs of the printed trade press, specifically by technology magazines such as Maschine + Werkzeug (23 articles), Maschinenmarkt (21), Produktion (18), Springer Professional (13), Industrieanzeiger (12), VDI-Z (10), and VDI-nachrichten (9).

Individual stories about the activities of the Fraunhofer IPT were picked up by national newspapers such as the Handelsblatt, the Frankfurter Allgemeine Zeitung and the Tagesspiegel. The finals of the "Excellence in Production" competition also made it into both dailies of the Aachen region and several other regional newspapers.

Top Topics of the Trade Press

Over the course of the year 2018, the Fraunhofer IPT distributed a total of 32 press releases.

The Fraunhofer High Performance Center "Networked Adaptive Production" topped the list of Fraunhofer IPT topics that were picked up by the press, accounting for 32 articles about the launch of the International Center for Networked Adaptive Production (ICNAP) and the use of 5G cellular network technology at the Hannover Messe in the spring of 2018.

The "Excellence in Production" competition once again attracted a good deal of attention from the press, accounting for 24 articles. The finals of this contest and particular the annual award of the prize for the "Toolmaker of the Year" are Fraunhofer IPT's steady sellers on the market for public attention.

The third place on the internal podium for the "Topics of the Year" went to the personnel changes at the top of the Fraunhofer IPT: 21 articles were published about the succession of Professor Fritz Klocke as the Head of the Fraunhofer IPT by Professor Christian Brecher and as the Chair of Manufacturing Technology of the WZL of the RWTH Aachen University by Professor Thomas Bergs.

Other stories of interest included joint research studies with the WBA Tooling Academy Aachen (15) and the establishment of a German-Japanese expert consortium for Optical Coherence Tomography (14). On top of that, a number of press organs carried Fraunhofer IPT news from fields such as Additive Manufacturing by Laser Deposit Welding (7), SLM supporting structures for complex components (9) and the establishment of a joint venture with the Aachen Center for Additive Manufacturing ACAM (8). Some of these articles were published in connection with the media coverage of the Formnext trade exhibition.

Social Media

Press releases were also distributed via various social media platforms including LinkedIn, Facebook, Twitter, Instagram, Xing and Youtube.

The highest number of social media hits were counted for our releases about the High Performance Center, ICNAP and the 5G networks of the Hannover Messe. In the period between 6 February and 25 April 2018, our own reports about the Institute's activities – not counting reactions on shared posts – in Facebook, Twitter, LinkedIn and Instagram accounted for more than 38,000 Impressions and over 400 likes.

By the end of 2018, the Fraunhofer IPT had approx. 2520 followers at LinkedIn, 1600 for its Facebook pages, 1380 at Twitter, 900 at Instagram, 750 at Xing and 630 at Youtube.


EIP
2018

FAIRS AND EVENTS

FAIRS

- Photonics West, 27.1.-1.2., San Francisco (USA)
- JEC, 6.-8.3., Paris (F)
- Light & Building, 18.-23.3., Frankfurt
- Hannover Messe, 23.-27.4., Hannover
- ILA, 25.-29.4., Berlin
- Control, 24.-27.4., Stuttgart
- Optatec, 15.-17.5., Frankfurt
- ASME Turbo Exhibition, 11.-15.6., Lillestrøm (N)
- Automatica, 19.-22.6., München
- Farnborough Air Show, 16.-22.7., Farnborough (UK)
- IMTS Chicago, 10.-15.9., Chicago (USA)
- Fakuma, 17.-21.10., Friedrichshafen
- EuroBLECH, 23.-26.10., Hannover
- Composites Europe, 6.-8.11., Stuttgart
- Formnext, 13.-16.11., Frankfurt
- Electronica, 13.-16.11., München
- Precisiebeurs, 14.-15.11., Veldhoven (NL)

Conferences

- Aachen Polymer Optics Days,10-11 April., Aachen, Germany
- Opening of the International Center for Networked, Adaptive Production (ICNAP), 25 April, Hanover
- 3rd Fraunhofer Alumni Summit in Aachen, 28-29 September, Aachen
- Conference "Medical Imaging - New Perspectives and the Role of OCT", November 8, Tokyo (JP)
- 18th International Colloquium "Tool and Die Making for the Future", 13-14 November, Aachen
- Final Conference Consortium Benchmarking "Agile Invention, 28 November, Aachen.

Recruiting Events

- MINT evening for students at the Anne Frank Gymnasium, 7 March,Aachen
- Hannover Messe , 23-27 April, Hannover
- Girls' Day 2018, 26 April, Aachen
- Summer party of the IT Department of the RWTH Aachen University, 8 June, Aachen
- Femtec.Network meets, 21 September, Berlin
- Der Dom leuchtet, 28 September, Aachen
- Guided tours of the Institute for first-year students from the RWTH Aachen University (Department 4), 8-12 October, Aachen
- 5 vor 12 – RWTH Wissenschaftsnacht, 9 Novenber, Aachen
- Absolventenkongress Deutschland, 22-23 November, Cologne
- bonding Firmenkontaktmesse, 5 December, Aachen
- Future Day for women at the RWTH Aachen University, 11 December, Aachen

For more information on conferences, exhibitions and seminars visit our website

www.ipt.fraunhofer.de/dates

Honors and awards

Special Award
from the Department for Mechanical Engineering of the RWTH Aachen University to **Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dr. h.c. Fritz Klocke** for his lifetime achievements in teaching

Taylor Medal of the International Academy for Production Engineering (CIRP)
Dr.-Ing. Dr. rer. nat. Markus Zeis
for his paper on "Deformation Of Thin Graphite Electrodes With High Aspect Ratio During Sinking Electrical Discharge Machining"

Best Tutorial Award of the ASME Turbo Expo 2018
Dr.-Ing. Sascha Gierlings
for his Tutorial Session "Advanced Turbomachinery Manufacturing" at the Turbo Expo 2017 in Charlotte, NC (US)

Third Place of the Elevator Pitch
in the Fraunhofer Brainstorming Contest "Netzwert 2018"
Malena Schulz
for her project proposal in regenerative medicine

Certificate "Fraunhofer Research Manager"
Dr.-Ing. Reik Krappig
Graduate of the third course of the Fraunhofer program for strategic skills development

Two-year Fellowship
in the internal "Young Research Class" program of the Fraunhofer-Gesellschaft
Emily Harnisch
for her paper on "Eye Implants" in the research field of biological transformation

Scholarship of the Stiftung Industrieforschung
Svenja Nohr
for her Master's Degree thesis about SLM-based interference lithography

Award of the Chamber of Industry and Commerce, Aachen
Timm Heitmeyer
for the overall final grade of Excellent following his apprenticeship as an IT specialist for systems integration

Award of the Fraunhofer-Gesellschaft
Larissa Pützinger
for the overall final grade of Excellent following her apprenticeship as a management assistant in office communication

Award of the Fraunhofer-Gesellschaft
Sergej Hahn
for the overall final grade of Excellent following his apprenticeship as an IT specialist for systems integration

German Light Design Prize in the "Light Art" category
Annette Sauermann
for the artwork "Networks of Knowledge" installed on the housefronts of the Aachen-based Fraunhofer Institutes

REFERENCES


10 x technology
ABB
AACHEN CENTER FOR ADDITIVE MANUFACTURING
ACSYS LASERTECHNIK
AIXEMTEC
aix tooling
AIXTRON
ALZMETALL
AMETEK ULTRA PRECISION TECHNOLOGIES
auer LIGHTING
AZL RWTH AACHEN UNIVERSITY
BASF We create chemistry
B BRAUN SHARING EXPERTISE
Beiersdorf
BERLINER GLAS
brose Technik für Automobile
B/S/H/
CDA We inspire and manufacture value
Coatema
DEUTSCHE PRIVATE EQUITY
Edscha
e.GO
EMAG
ERICSSON
ETALON APPLIED TRACEABILITY
FiA Dr. Fichtner GmbH & Co. Industrieanlagen KG
fionec fiber optic sensor technologies
FISBA Innovators in Photonics
fraisa
formnext
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infineon
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JOHN DEERE
IKEX. Knowledge Exchange
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THORLABS
thyssenkrupp
TOYOTA
UNIVERSITY OF TWENTE.
viega
WALTER
WALTER KÖRBER SOLUTIONS
WBA WERKZEUGBAU AKADEMIE
WEINIG
WINDMOELLER & HOELSCHER CORPORATION
WZL RWTH AACHEN UNIVERSITY
ZECHA GERMANY
...

EDITORIAL NOTES

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www.ipt.fraunhofer.de/en/always-well-informed.html

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