MATERIALS CENTER LEOBEN
FORSCHUNG GMBH

ANNUAL**REPORT 2014**

14

COMET K2 Centre MPPE

Company partners

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„Materials technologies are an indispensable foundation of our modern life.“

Univ.-Prof. Dr. Reinhold Ebner
Managing Director

Management Report 2014

15th anniversary

Anniversaries always provide a good opportunity not only to look back, but also to look ahead to the future. This is why we celebrated the 15th anniversary of MCL not only by reflecting on accomplishments of the past, but also by highlighting our perspectives and future prospects together with representatives from politics, shareholders, funding providers and partners from science and industry, and our employees.

Founded in October 1999, MCL operated as a Kplus Centre until 2007 and then participated in the first call for COMET K2 Centres in 2008. The application was successful and MCL became the operating organisation of one of Austria's first three COMET K2 Centres. The first phase of the K2 Centre MPPE (Integrated Research in Materials, Process and Product Engineering) ran from 2008 to 2012. The successful mid-term evaluation was followed by a second funding period, which is scheduled to continue until 31 December 2017. MCL also plans to participate in the third call for COMET K2 Centres in 2016 in order to continue to engage in COMET research projects together with company and scientific partners from 2018.

Business development 2014

2014 was year two of the second funding period (Phase II) for the COMET K2 Centre for Integrated Research in Materials, Processing and Product Engineering (MPPE). During this funding period (2013 to 2017), MCL and its company and scientific partners have access to a COMET project volume of 59.5 million euros. Since some new projects of COMET Phase II had already started in Phase I, it was possible not only to avoid a slump in projects during the transition phase but also to generate substantially larger annual COMET volumes than originally planned for 2013 and 2014 due to the overlapping of completed projects from Phase I and new projects from Phase II.

The non-K area, i.e. activities outside the COMET programme, was considerably expanded in 2014. MCL was able to substantially increase the non-K research volume by increasing turnover from company contracts and by winning projects funded under national (e.g. Production of the Future) and international (ENIAC) programmes.

Total investments of approx. 1.3 million euros were made in the financial year 2014. The focus of investment continued to be on expanding the microelectronics sector and driving forward the expansion of the mechanical testing lab.

The implementation of COMET Phase II was largely completed in 2014 and we could increasingly turn our attention to future topics. MCL launched the strategy process for the next COMET Phase starting in 2018. MCL also stepped up its project acquisition efforts by submitting numerous applications to national and international research programmes.

We also initiated measures to enhance MCL's international visibility by increasing the number of publications in renowned journals and organising conferences and workshops.

MCL also stepped up its efforts to build a patent portfolio with the aim to secure access to future research fields.

Other highlights in 2014

The first meeting of the International Scientific Advisory Board (ISAB) was held in February 2014.

Mag. Alexandra Purkarthofer took up her position as new Commercial Director of MCL in March 2014.

The Leoben based research institutions participated in the "Long Night of Research" for the first time in April 2014. Nearly 1,600 visitors used the opportunity provided by this popular event to learn more about the range of research carried out in Leoben. MCL also drew large crowds. The presentation "Making a mountain out of a molehill" gave interested visitors an easy to understand and illustrative insight into the whole topic of electron microscopy.

MCL used the 15th anniversary as an opportunity to modernise its advertising line and develop new designs for its business areas STEEL, TOOLS, MICROELECTRONICS and SERVICES. The new image brochure was printed in autumn 2014.

MCL received the prestigious "Leitbetriebe Austria" certificate awarded to leading Austrian companies during the 15th anniversary event in November 2014.

In December 2014 MCL organised the 1st International Conference for Functional Integrated nano Systems (NanoFIS) in Graz together with Techkonnex.

Outlook for 2015

A COMET project volume of approx. 12.9 million euros is planned for 2015, which again exceeds the average annual COMET volume for the current funding period.

A slight increase over the 2014 figures is planned for the unfunded non-K area. Several measures have been introduced to further increase the project volume in the funded non-K area, with a special focus on raising participation in international programmes. The new national and international projects acquired for 2015 will lead to a substantial increase compared to the previous year. Growth in this area is, however, limited by several factors. Calls for national and international research programmes are increasingly oversubscribed, thus reducing the success ratios for applications. Other limiting factors include bearing the cost of submissions, covering non-eligible costs and acquiring the necessary match funding for the projects.

Investments totalling approx. 1.4 million euros are planned for 2015. The focus of investment will be in the fields of materials engineering and microelectronics.

The new MCL strategy drawn up in 2014 will be integrated into a concept for the next COMET funding period. The concept to be developed in 2015 will be based on the business plan, which defines the key topics for the next COMET phase. These topics will subsequently be integrated into the research programme for the next COMET phase and coordinated with the activities of the company and scientific partners.

We are confident that by continuing and expanding the measures taken in 2014, MCL will succeed in enhancing its international visibility in the long term.

„Research brings innovation by people for people"

Mag. Alexandra Purkarthofer, MBA
Managing Director

„Where research turns into innovation“

Magn. Univ.-Prof. Dr. Wilfried Eichlseder
(Chairman of the General Meeting)

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Shareholder Statement

15th anniversary of MCL

MCL celebrated its 15th anniversary in 2014. A festive event was organised to look back on the successes of the past, to present current developments and to highlight perspectives for the future together with representatives from politics, funding providers, shareholders and partners. Established in October 1999 with only two employees, MCL has meanwhile developed into a leading materials research centre with around 150 staff conducting research and development at international level.

As in 2013, the project volume again significantly exceeded the € 11.9 million annual average for COMET Phase II, a success which is largely due to intensive planning and preparation for the funding period. In the non-COMET area, the volume of nationally and internationally funded projects as well as turnover from non-funded research assignments and services also increased substantially in 2014.

Internationalisation

Raising its international profile and establishing an International Scientific Advisory Board have been defined as key tasks for MCL in COMET Phase II. The following measures were implemented in 2014 to increase MCL's international profile and visibility:

- Launch of numerous projects with new international partners from science and industry in the COMET and non-COMET areas
- Establishment of scientific contacts to North American universities as part of a project
- Recruitment of international researchers
- Focus on publications in internationally recognised reviewed journals
- Organisation of international conferences/workshops
- Active participation of MCL staff in international research and scientific bodies
- First meeting of the International Scientific Advisory Board (ISAB) appointed in 2013

Report from the General Meeting

The Management Board and the Supervisory Board reported at two General Meetings held in 2014. Mag. Alexandra Purkarthofer took up her position as MCL Commercial Director on 1 March 2014.

The annual accounts for 2014 were unanimously approved and the Management Board and the Supervisory Board were formally discharged for 2014. The shareholders would like to thank the members of both boards for their excellent work.

The owners are very pleased about MCL's positive business development and scientific achievements. Its continued trend for growth is also reflected in the budget allocated for 2015, which provides for further increases.

Shareholder structure of Materials Center Leoben Forschung GmbH:

47,5 %	Montanuniversitaet Leoben
17,5 %	JOANNEUM RESEARCH Forschungsgesellschaft mbH
15,0 %	Municipality of Leoben
12,5 %	Austrian Academy of Sciences
5,0 %	Vienna University of Technology
2,5 %	Graz University of Technology

Dr. **Martha Mühlburger**
Chair
delegated by Montanuniversitaet Leoben

Dr. **Bruno Hribernik**
Deputy Chair
appointed by the General Meeting

Dr. **Knut Consemüller**
appointed by the General Meeting

From the Supervisory Board

Univ.-Prof. Dr. **Gerhard Dehm**
delegated by the Austrian Academy of Sciences

Financial year 2014

In the second year of COMET Phase II, the COMET project volume again significantly exceeded the € 11.9 million annual average for the funding period due to excellent planning and preparation. The volume in the non-COMET area also increased substantially, with a steep increase in the proportion of internationally funded projects and the share of projects funded from national scientific funds. In 2014, MCL was involved in four EU projects, acting as a coordinator in one of them, and also in 12 nationally funded projects.

MCL took various measures to increase its international profile and visibility, for example by acquiring numerous new international scientific and company partners and organising international workshops and conferences. 2014 also saw the first meeting of the International Scientific Advisory Board (ISAB), which was established to provide MCL with advice concerning its long-term scientific and technological orientation and increasing its international visibility.

Following the departure of the Commercial Director in 2013, Mag. Alexandra Purkarthofer took over this position on 1 March 2014. The Supervisory Board wishes her every success for her new task.

Mag. **Katharina Kocher-Lichem**
appointed by the General Meeting

Univ.-Prof. Dr. **Wolfgang Pribyl**
delegated by JOANNEUM RESEARCH Forschungsgesellschaft mbH

SChef a.D. Senator h.c. Dr. **Norbert Rozsenich**
delegated by Montanuniversitaet Leoben

Univ.-Prof. Dr. **Christof Sommitsch**
delegated by Graz University of Technology

Dr. **Christian Wolf**
delegated by Vienna University of Technology

Strategic development and challenges

In addition to the successful implementation of the COMET programme, MCL will also continue to work intensively on the development of the non-COMET area in order to enhance its expertise outside its established fields and diversify its financial base. MCL sees great potential in submitting projects to the EU's 'Horizon 2020' programme, various international Joint Undertakings and the FFG's national 'Production of the Future' programme, although calls for these programmes are increasingly oversubscribed. Turnover from non-funded research assignments and services will continue to grow in the next few years in line with the increasing experience of MCL staff and continuous expansion of the infrastructure.

These strategic developments will only work if MCL succeeds in further expanding its partner network with national and international companies and universities/research institutions and increasing its international presence.

Another focal point of MCL in the next few years will be the registration and exploitation of intellectual property rights. Research carried out by MCL has resulted in numerous improvements and innovations among its company partners. The future focus will be on using this expertise not only at the research partners but also examining its potential application in other companies and industries.

From the COMET K2-Programme Committee

Representatives of company partners:

Dr. **Christoph Auer**
EPCOS OHG - A Group Company of TDK-EPC Corporation

DI **Josef Hagler**
voestalpine Stahl GmbH

Dr. **Christian Hinteregger**
MAGNA Powertrain AG

Dr. **Harald Leitner**
Böhler Edelstahl GmbH & Co KG

Dr. **Raimund Ratzi**
Miba AG

Dr. **Martin Schrems**
ams AG

Dr. **Axel Sormann**
voestalpine Metal Engineering GmbH & Co KG

Tasks of the Programme Committee

The Programme Committee reviews, assesses and approves new research projects for inclusion in the research programme of the COMET K2 Centre MPPE. The proposed projects are assessed in terms of their coherence with the objectives of the MPPE research programme, their contribution to achieving the goals of the MPPE research programme and their compliance with the requirements specified for the second funding period, i.e. scientific and/or technological excellence, level of innovation and practical applicability of the results.

Representatives of scientific partners:

Assoz. Prof.
Dr. **Norbert Enzinger**
Graz University of Technology

Univ.-Prof.
Dr. **Florian Grün**
Montanuniversitaet Leoben

Univ.-Prof. Dr. **Otmar Kolednik**
Austrian Academy of Sciences

Univ.-Prof.
Dr. **Ernst Kozeschnik**
Vienna University of Technology

Univ.-Prof.
Dr. **Christian Mitterer**
Montanuniversitaet Leoben

Univ.-Prof.
Dr. **Johannes Schenk**
Montanuniversitaet Leoben

Mag. Dr. **Barbara Stadlober**
JOANNEUM RESEARCH Forschungsgesellschaft mbH

New member of the Programme Committee

In 2014 Dr. Gerhard Jesner withdrew from the Programme Committee and Dr. Harald Leitner (also Böhler Edelstahl GmbH & Co KG) was appointed new member of the Programme Committee.

New projects approved by the Programme Committee

In 2014, the Programme Committee approved a total of 16 new projects with a total volume of around EUR 15 million for inclusion in the COMET Programme. Requirements were imposed for some of the projects. The projects continued from COMET Phase I and the projects approved in 2013 and 2014 together already account for around 92% of the total project volume for COMET Phase II.

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International Scientific Advisory Board (ISAB)

Tasks of the International Scientific Advisory Board

The International Scientific Advisory Board (ISAB) advises MCL in devising a long-term scientific strategy and proposes measures to enhance its international profile and visibility. The ISAB also supports MCL in its efforts to become involved in international R&D networks.

Members of the ISAB

The ISAB currently comprises 11 members and is scheduled to meet annually.

Name	Institution
Prof. Eduard Arzt (DE)	University of Saarland, INM – Leibniz-Institut für Neue Materialien GmbH
Prof. Michal Basista (PL)	KMM-VIN and Head of Advanced Composite Materials Group, Institute of Fundamental Technological Research, Polish Academy of Sciences
Prof. Wolfgang Bleck (DE)	RWTH Aachen – Department of Ferrous Metallurgy
Prof. Franc Cus (SI)	University of Maribor
Prof. Wilfried Eichlseder (AT)	Montanuniversitaet Leoben
Prof. Peter Fratzl (DE)	Max-Planck Institute of Colloids and Interfaces, Department of Biomaterials
Prof. Fritz Klocke (DE)	Fraunhofer Institute for Production Technology and RWTH Aachen
Prof. Herbert Mang (AT)	Vienna University of Technology, Austrian Academy of Sciences
Prof. Andreas Mortensen (CH)	EPFL Lausanne – Laboratory for Mechanical Metallurgy
DI Reinhard Petschacher (AT)	Formerly Infineon
Prof. Anke Kaysser-Pyzalla (DE)	Ruhr University Bochum, Helmholtz Zentrum Berlin

First ISAB meeting

The first meeting of the International Scientific Advisory Board took place on 13 and 14 February 2014 in Leoben, where MCL presented its COMET research programme and objectives to the members of the ISAB. A range of scientific questions were raised and discussed in the course of the presentations. The members of the ISAB then held an internal meeting to formulate feedback and suggestions for MCL.

The MCL Management wishes to thank the members of the International Scientific Advisory Board for their willingness to join this advisory committee.

15 years of MCL

THE MATERIALS CENTER LEOBEN CELEBRATES 15 YEARS OF EXCELLENT RESEARCH EXPERTISE

Materials Center Leoben Forschung GmbH celebrated its 15th anniversary on Wednesday, 12 November 2014. The MCL Managing Directors, Dr. Reinhold Ebner and Mag. Alexandra Purkarthofer welcomed numerous guests from politics, industry and science at the festive event held on the occasion in the assembly hall of Montanuniversitaet Leoben. The host of the event was Leoben-born Mag. Ina Sabitzer. The speakers looked back on how MCL has developed from a Kplus Centre to one of Austria's five K2 Centres over the past 15 years and provided an outlook on what the Leoben research centre aims to achieve in future. Well-wishers from politics included Regional Minister Dr. Christian Buchmann, Leoben Mayor Kurt Wallner and representatives from the Ministry of Science, Research and Economy and the Ministry of Transport, Technology and Innovation. In their speeches, the Rector of Montanuniversitaet Leoben, Dr. Wilfried Eichlseder, and representatives of industry and science all emphasised the important role of materials research and materials technology in strengthening Austria's position as an industrial location in the face of global competition.

To top off the event, MCL received the prestigious "Leitbetriebe Austria" certificate from Mag. Monica Rintersbacher, Managing Director of the organisation "Leitbetriebe Austria". The certificate is awarded to leading Austrian companies that stand out for their commitment to corporate innovation, sustainability and social responsibility.

The guests had an opportunity to take a look behind the scenes in the MCL laboratories after the ceremony, where they learned more about the research activities in many different fields. The event was rounded off at the Impulse Centre for Materials (IZW) where the celebration mood continued in a relaxed and informal atmosphere with a buffet and an anniversary cake.

Facts and figures from the first 15 years of MCL:

- € 125 million in research volume
- 189 COMET and Kplus projects, 25 NonK-projects and numerous research assignments
- € 13 million in investments
- 214 degree theses (of which 99 doctoral theses)
- Over 1,000 publications
  - 587 in scientific journals
  - 424 conference papers
- Increase to 153 staff
  - of which 29% women
  - of which 18% from abroad

LEITBETRIEBE AUSTRIA

RESEARCH PROGRAMME COMET K2 MPPE

Innovation through integrated materials, process and product engineering

Overview of COMET Phase II

Highlights:

- **Slicing through the Alps**
- **Flexible and modern steel structures**
- **Pumps made of plastic instead of concrete?**

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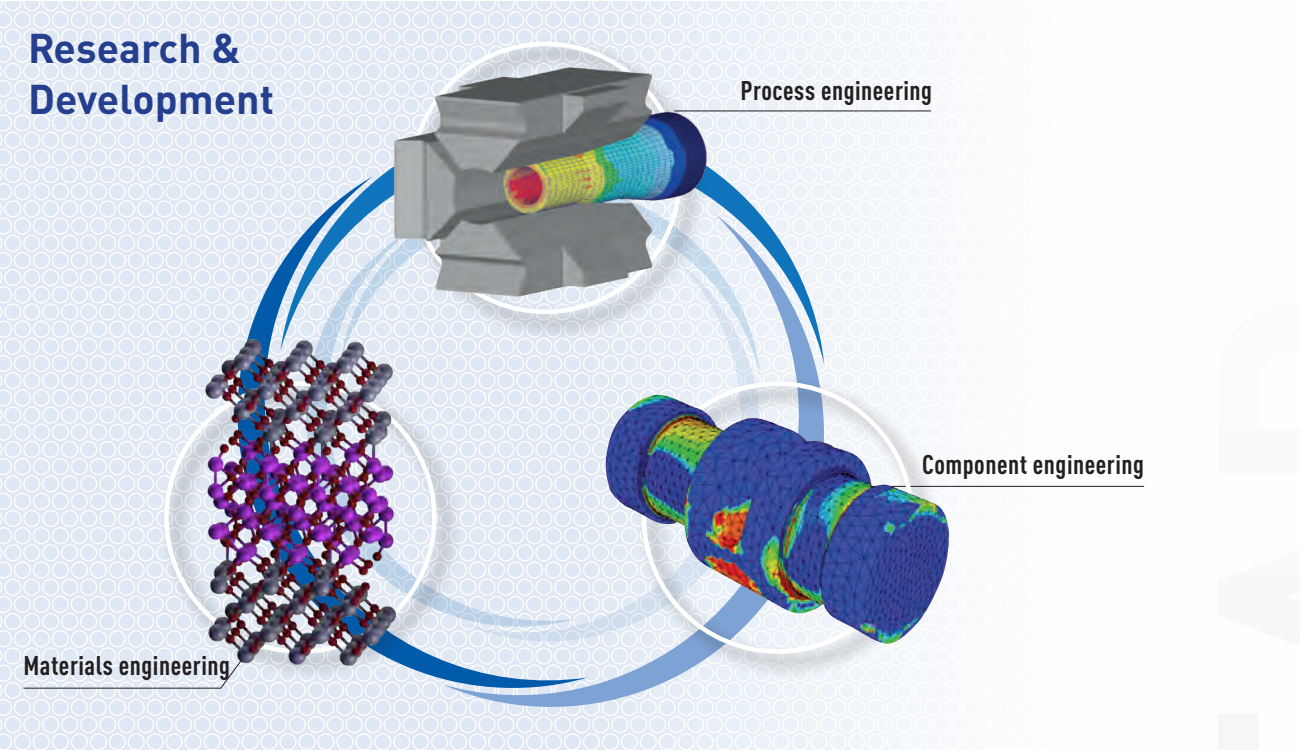
Innovation through integrated materials, process and product engineering

The COMET K2 Centre for "Integrated Research in Materials, Processing and Product Engineering (MPPE)" provides a platform for MCL to carry out innovative materials research projects together with partners from industry and science.

Integrated materials, process and product development offers an enormous potential for innovation, cost reduction and resource efficiency, a potential that has scarcely been exploited to date due to the complex interactions involved.



This is where MPPE comes in: seamless simulations of complex sequential manufacturing processes enable a detailed understanding and numerical description of the processes involved across the entire value chain, from materials synthesis to the end of the component lifecycle.

The most significant advantages include shorter process times, lower production costs, higher quality, lower consumption of energy and material resources, improved design concepts and enhanced reliability. MPPE uses its detailed understanding of the entire value chain to develop innovations involving new materials, new processes and new high-strength structural parts as well as components with new functional properties.

This approach is used to exploit and extend the load limits of materials and components and reduce both unit costs and time to market, resulting in innovative high-strength products.

The research projects, especially the strategic projects, provide the industrial partners with fundamental expertise and simulation methods required for the development of new processes and products.

The COMET Programme gives the company partners access to the latest scientific findings, state-of-the-art simulation and experimental methods and also the opportunity to implement innovative funded research projects together with scientific research institutions and other industrial partners. The project teams usually cover the entire value chain; but there are also cases where competing companies join forces to work on application-oriented fundamentals.

The long-term strategic projects provide the fundamentals for future developments. They are designed to ensure a sustainable research and development basis for the years to come.

The COMET research activities carried out in long-term projects in 2014 accounted for around 81% of the MCL volume. Some 12% of turnover came from direct research and development assignments or service activities and around 7.5% of the project volume came from research projects funded under other national and international research programmes.

Overview of COMET Phase II

Project volume and financing of COMET Phase II:

Phase II of the COMET research programme runs from 1 January 2013 to 31 December 2017. A total volume of € 59.5 million in funding has been granted to MCL for this period.

MCL and the scientific partners account for about € 48.5 million of the project volume. The company partners will provide in-kind contributions of at least € 11 million, thus making an essential contribution to the success of the projects and also to the implementation of the project results in the companies. The amount of € 11 million only includes the contributions to be claimed; the actual contributions will be significantly higher.

The financing of the project volume of € 59.5 million for COMET Phase II is as follows: public funding: € 29.75 million; in-kind contributions by the scientific partners: approx. € 3 million; contributions by the company partners: € 26.8 million, of which € 15.8 million in cash and around € 11 million in kind.

The Austrian Research Promotion Agency (FFG), the Styrian Business Promotion Agency (SFG) and the Business Promotion Agency Tyrol will provide 50% of the total funding volume, another 5% will be contributed by the scientific partners in the form of in-kind contributions.

Period	2013 to 2017
Planned COMET project volume (€ million):	**59.5**
of which MCL and scientific partners	48.5
of which company partners	11,0
COMET financing (€ million):	**59.5**
Federal funding	19.8
Provincial funding	9.9
In-kind contributions by scientific partners	3.0
Cash contributions by company partners	15.8
In-kind contributions by company partners	11.0

„Research and innovation are the basis of our prosperity“

Dr. Werner Ecker
Manager Simulation

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Project volumes in 2013 and 2014:

The COMET volumes achieved in 2013 (€ 13.9 million) and 2014 (€ 12.6 million) clearly exceeded the average annual value of € 11.9 million for COMET Phase II. This was due to the launch of many new projects resulting from the planning phase for the second funding period and the completion of projects from the first funding period.

Projects and project development in 2013 and 2014:

All COMET projects are cooperative research and development projects carried out in close cooperation between MCL and its scientific and company partners. The projects typically run for three to five years with budgets ranging between € 500,000 and € 2,500,000. Both the volume and the complexity of the projects have increased substantially over the past few years.

A total of 21 projects from COMET Phase I were completed in 2013 and 2014. Another 22 projects from the first funding period were still ongoing at the end of 2014. A total of 27 new projects were started in 2013 and 2014.

Projects 2013 and 2014	
- completed in 2013 and 2014	21
- ongoing at the end of 2014	49

Publications and patents:

A total of 198 publications were published in 2013 and 2014, of which 113 appeared in refereed journals. Scientific publications in this period also included 235 other contributions (posters, presentations etc.).

One patent was filed in 2013 and 3 patents in 2014. The number of patents is expected to increase substantially over the next few years, as the competence centre reaches a higher level of maturity.

Publications 2013 and 2014:	**198**
of which in refereed journals	113
of which in conference proceedings etc.	85
Patents 2013 and 2014:	**4**

Degree theses:

A total of 21 doctoral theses and 16 diploma/master's theses were completed in 2013 and 2014. Another 58 academic theses (53 doctoral theses and 5 diploma/master's theses) were ongoing at the end of 2014.

Doctoral theses:		**74**
	completed in 2013 and 2014	21
	ongoing at the end of 2014	53
Diploma/Master's theses:		**21**
	completed in 2013 and 2014	16
	ongoing at the end of 2014	5

COMET partners:

79 company partners and 46 scientific partners were involved in the research programme of COMET Phase II in 2013 and 2014.

Company partners:		**79**
	national	41
	Europe	35
	Overseas	3
Scientific partners:		**46**
	national	31
	Europe	14
	Overseas	1

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Research areas:

The COMET K2 Center for "Integrated Research in Materials, Processing and Product Engineering (MPPE)" focuses on the core areas of the value chain and covers in particular the following fields:

1. Development and characterisation of materials
2. Materials synthesis
3. Design and testing of parts and functional components
4. Materials processing into parts and functional components
5. Behaviour of materials in service

The scientific objectives of the individual research areas were revised and updated for COMET Phase II (2013 to 2017). Multidisciplinary projects are carried out in the following seven research areas to be able to investigate both the scientific and technological aspects of the entire value chain for materials and components, from manufacture through to behaviour in service:

- Area 1: Virtual Integration of Materials, Process and Product Engineering
- Area 2: Multi-Scale Materials Design
- Area 3: Advanced Manufacturing Processes
- Area 4: Damage – Mechanisms, Evolution and Modelling
- Area 5: Tooling
- Area 6: Smart Concepts for Structural Components
- Area 7: Design and Reliability of Functional Components

The research activities will be illustrated by some examples:

- Slicing through the Alps
- Flexible and modern steel structures
- Pumps made of plastic instead of concrete?

Slicing through the Alps

There are huge numbers of rail and road tunnels running through the entire alpine region, as well as numerous underground caverns. Rock excavation work cannot always be carried out using explosives because of environmental and safety requirements. In such cases, tunnel boring machines or roadheaders have to be used instead. Today's mining industry is responsible for creating some extremely impressive products – not just the tunnels and caverns themselves, but also the machinery that is used to construct them. Sandvik Mining and Construction, which is based in Zeltweg, is a good example of a company that develops and produces this kind of advanced and extremely powerful self-propelled machinery.

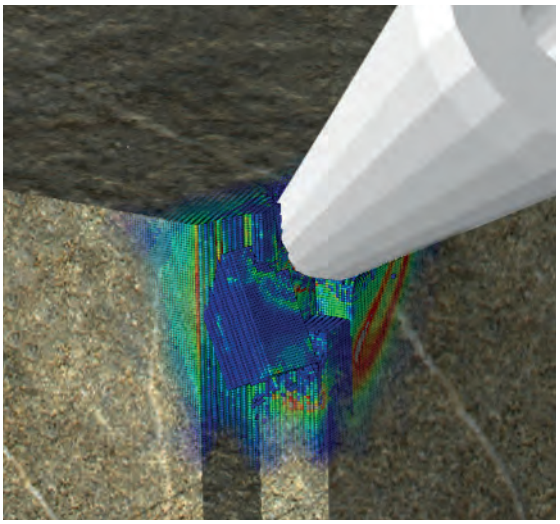
The cutter heads (picks) of the machines are subjected to extremely high mechanical and thermal loads. Therefore, to ensure that they can slice through the mountains smoothly and without any problems, one of the most important factors is to understand the interactions between the rock and the equipment.

Roadheader used in tunnel construction (© Sandvik Mining and Construction)

The research project

The research team from the Materials Center Leoben is working with Sandvik Mining and Construction to develop a set of typical rock characteristics with a view to describing the mechanical properties associated with the cutting process and evaluate them on MCL's high-end laboratory equipment. In addition, new calculation and simulation strategies are being developed. The insights gained from this successful cooperation make it possible to further improve the cutter heads and use them to excavate harder types of rock.

Roadheader breaking through a cavern (© Sandvik Mining and Construction)



New simulation methods for mining applications (© MCL)

Impact

By using advanced FE-based simulation methods, it is possible to predict the forces acting on the pick of the cutter head. In turn, this makes it possible to optimise the key parameters, such as the tool geometry, the rock properties and the technological process parameters. The insights gained will enable Sandvik Mining and Construction to enhance its equipment effectively and use it to excavate harder types of rock.

Flexible and modern steel structures

Heavy plate products – Strong and secure

High-strength heavy plate products have become an indispensable part of our everyday lives. For instance, they are used in the construction of bridges, mobile machinery (crane construction) and power stations. The use of high-strength heavy plate products is becoming increasingly important in these kinds of steel structures to ensure cost-efficient construction. This is because the wall thickness of the components can be reduced due to their higher strength. In turn, this results in a lower component weight. In addition to the direct savings achieved due to the lower material costs, additional cost savings emerge at the further processing and transport stages, and – in the case of mobile applications – during use.

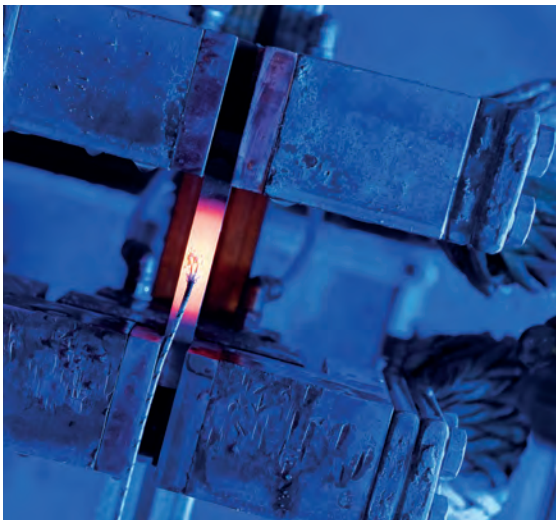
Heavy plate penstocks for a power station (Source: Materials Center Leoben Forschung GmbH)

Welded connections put to the test

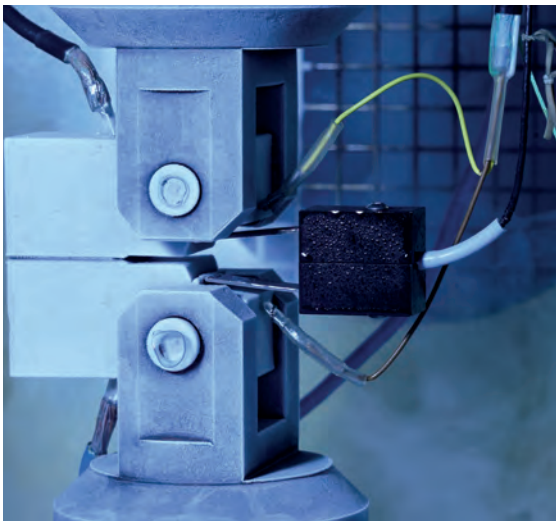
The individual plates are usually connected by means of fusion welding methods. During welding, the heat input changes the microstructure and – in turn – the properties of the material in the area around the weld seam, which is called the heat affected zone (HAZ). To ensure the operational reliability of the component, even the most delicate of these zones must meet stringent requirements in terms of toughness and strength.

For the purpose of assessing operational reliability, it is absolutely essential to quantify the toughness of these high-strength steels. Materials Center Leoben is using the latest fracture mechanical methods to test the strength of the materials within a temperature range of -150 to +500°C to analyse their behaviour under extreme conditions.

Fracture mechanics can also be used to estimate the impact of possible faults or defects within a component. MCL is specifically investigating how experimental results can be applied to the behaviour of real components and is using advanced numerical fracture mechanical methods to assess operational reliability.



Welding simulation (© voestalpine Grobblech GmbH)



Low-temperature fracture mechanical testing (@ MCL)

Working together to achieve the goal

A COMET research project was carried out in conjunction with various partners, including voestalpine Böhler Welding Austria GmbH and voestalpine Grobblech GmbH. As part of this work, the researchers systematically characterised the material behaviour of the individual heat affected zones and the weld metal of a modern high-strength heavy plate product. The material states in the individual heat affected zones were set deliberately by a physical simulation by voestalpine Grobblech GmbH. This involved exposing the material to the kinds of thermal cycles that are typically encountered around a weld.

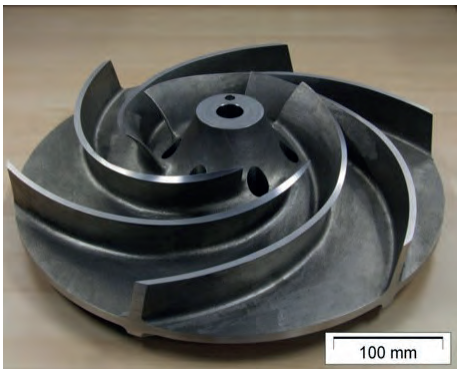
Impact

The fracture mechanical data obtained by MCL in the course of this project, together with the numerical calculations, will provide a solid foundation for the safe and reliable processing and use of high-strength heavy plate products, even under extreme conditions such as low or high temperatures.

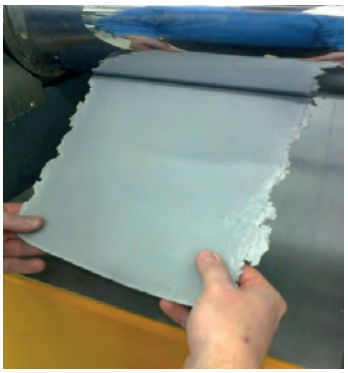
Pumps made of plastic instead of concrete?

Pumps must withstand tough conditions

Pumps have to perform all kinds of different tasks across the world – the materials used must therefore cope with enormous challenges, such as exposure to extreme heat or chemicals. However, one of the main problems of using pump components made from steel is that they involve high production and maintenance costs. Depending on the application, pump components may start to show signs of wear very early on, which reduces the service life significantly. The solution to this problem lies in identifying new materials for pump components that have lower production and maintenance costs than steel. With a view to replacing steel with other materials in the future, the researchers considered a wide array of substitute materials. They narrowed these down to polymers and a second group of materials called MDF (macro defect free) composites.



Pump impeller (all images © MCL)



MDF being produced in a batch process

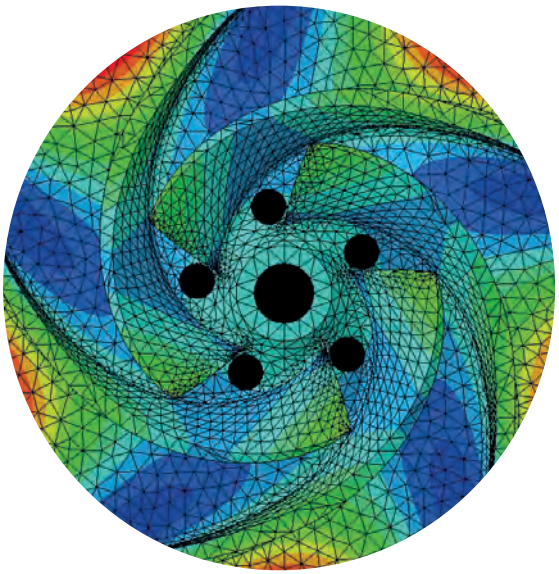
and in a compounder

Searching for new materials

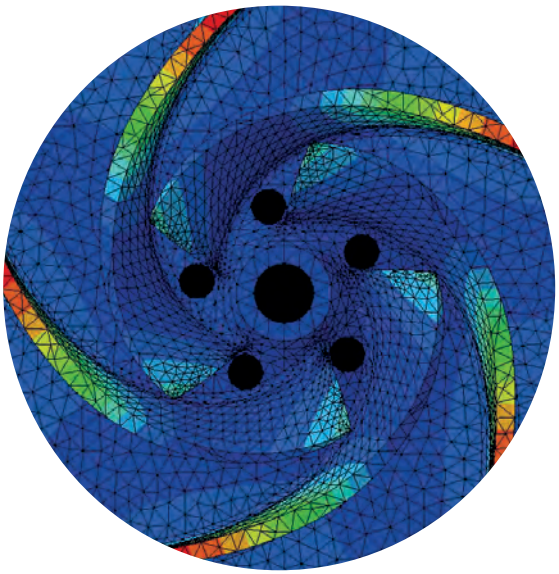
In view of their chemical stability, thermal stability (within certain applications) and mechanical properties, polymers represent a cost-efficient alternative to steel. The mechanical properties of these polymers can, for example, be improved even further by reinforcing them with fibres. The researchers considered the properties of a large number of polymers and selected the plastics that looked most promising from a materials database. The selected materials were then manufactured into compounds, some of which were reinforced with glass fibres. The mechanical and chemical properties of these new materials were identified and entered in the existing database. FEM simulations were used to calculate the stresses on the components, enabling the development of component designs based on the new materials. The most promising materials were manufactured into pump components for special applications using a tailored production process. The components finally underwent successful testing on a test bench.

As another alternative in addition to the polymers, an MDF composite was also investigated as a possible substitute material. MDF materials are composites made from Ca/Al cement and polyvinyl alcohol whose mechanical properties are heavily influenced by the polyvinyl alcohol used. The material has a low level of water resistance, which imposes certain restrictions on the possible applications of MDF. To gain a better understanding of the material system and the production process of

MDF composites, the researchers started by creating samples on a laboratory scale. These samples were subsequently analysed for their mechanical, chemical and certain physical properties as also their mineralogical composition. In addition, setting experiments were carried out to gain a better understanding of the chemical reactions and processes that take place during setting. The next step was to produce larger quantities in the compounder, which resulted in samples with relatively good mechanical properties. As a result, the researchers were able to test the materials under real usage conditions – an enormous advantage when developing new materials.



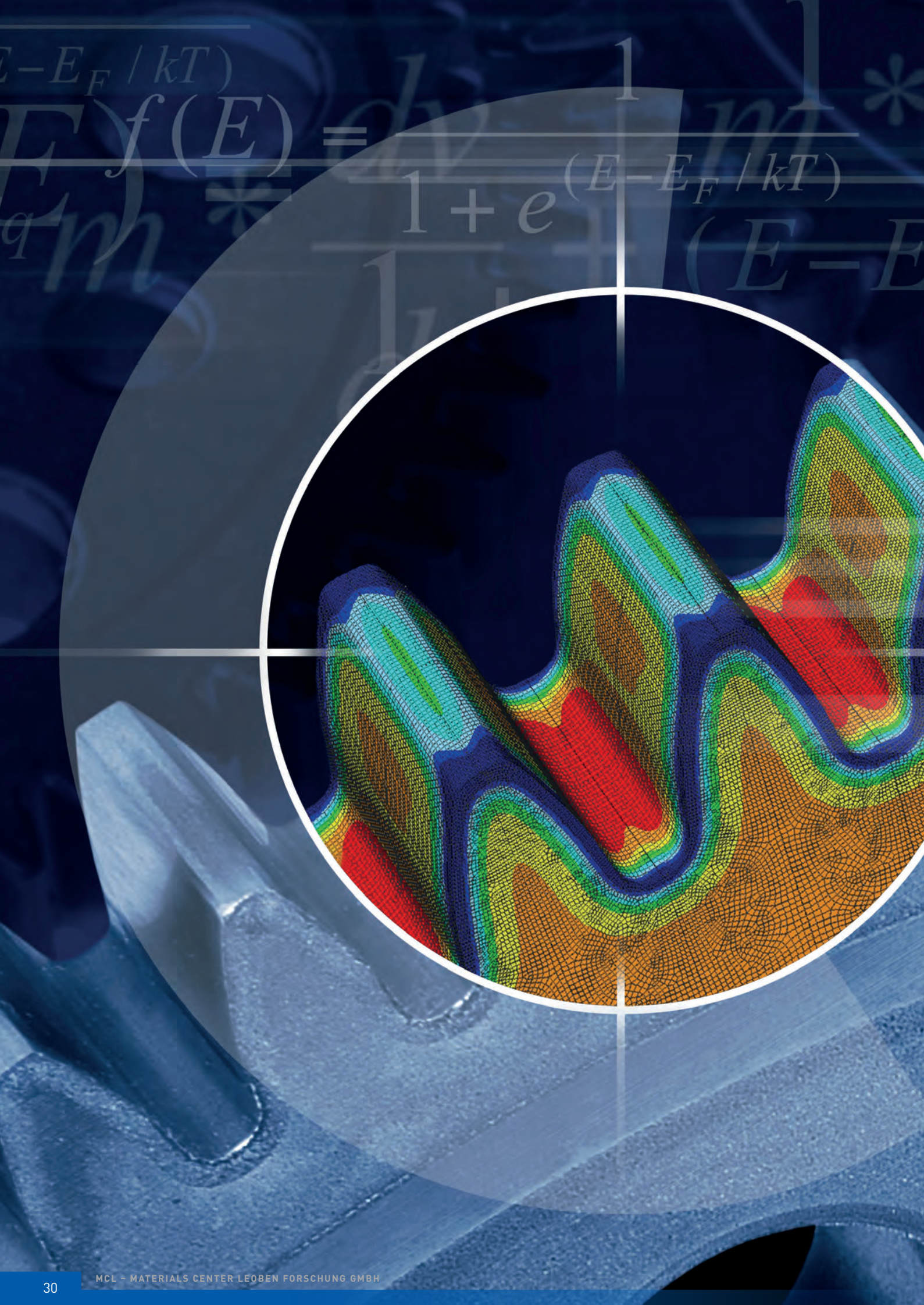
Investigation of a pump component under stress: Example of axial deformation



Example of radial deformation (all images © MCL)

Impact

Together with industrial partner Andritz AG (Pump Division) and partners at Montanuniversitaet Leoben and the Slovak Academy of Sciences, MCL is researching pump components made from alternative materials. This work has already started bearing fruit: the researchers are already producing the first pump components made from polymers and testing them on test benches. The project has enabled a detailed understanding of the production process of MDF composite materials, the mineralogical composition of the materials, the chemical reactions that occur during production and the setting process, and the impact of secondary reactions in the event of contact with water. In addition, the production process has been tested under realistic industrial conditions. This involves the use of a technique called compounding, which is usually associated with the polymer industry and had to be adapted to cement/PVA mixtures. The researchers have also succeeded in producing pump components made from reinforced polymer compounds. These initial components have performed extremely well in practical tests.




STEEL
INNOVATED BY MCL
STEEL

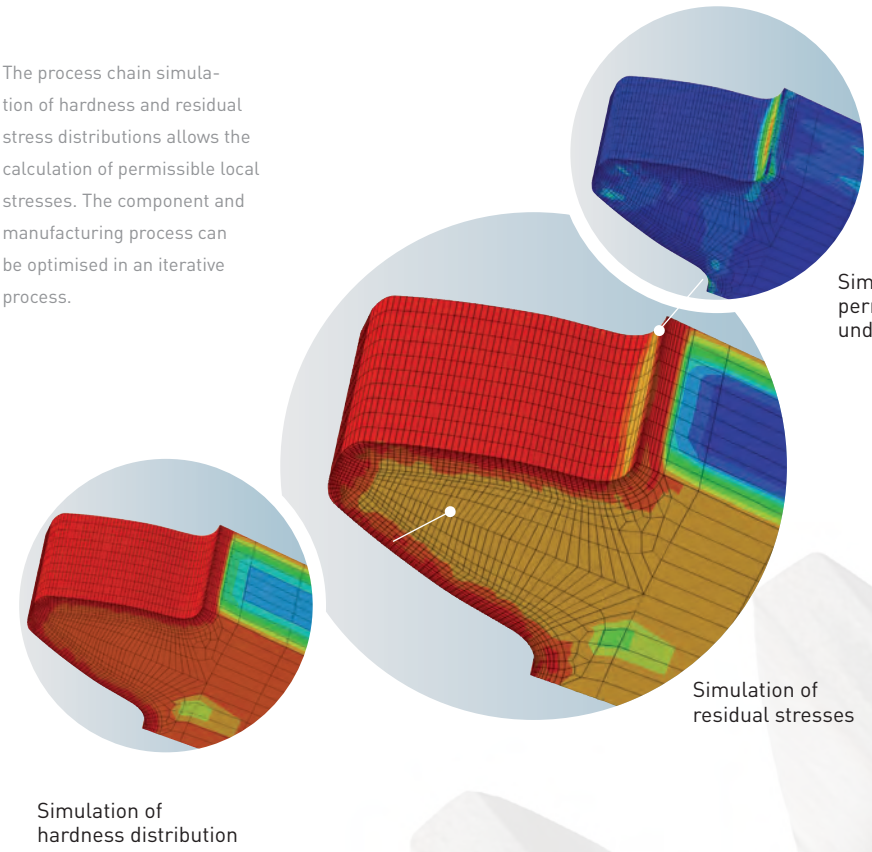
Steel

EXTENDING DIVERSITY

Steel comes in thousands of forms and qualities, making them ideal for a huge variety of applications. Although steel is sometimes considered an 'old' material, thanks to its versatility its potential is by no means exhausted. MCL understands steel in all its forms, right down to its atomic structure, making it the ideal partner when it comes to lending this complex materials group new and innovative facets.

Whether we're looking for something new or trying to improve what we have: only with a sound, theoretical and comprehensive understanding of steel in all its manifestations can we achieve our goals to develop new products for the benefit of our customers, optimising factors such as energy, material and time input in the manufacturing process, or improving service life and durability. Using state-of-the-art technical equipment, MCL is able to characterise the structure and properties of steel at all length scales, from microscopic samples through to complete components. MCL researches steels right down to their atomic level using high-performance computing infrastructure which enables state-of-the-art simulations to a standard previously undreamed of. MCL offers the highest levels of expertise in basic and applied research, focusing on the simulation of steels both in the manufacturing process and in service.

The process chain simulation of hardness and residual stress distributions allows the calculation of permissible local stresses. The component and manufacturing process can be optimised in an iterative process.



Materials and manufacturing technologies for the benefit of our customers

Selected applications:
Transmission components, ①
Tyre protection chains, ②
Rails / switch points, ③
Bearings, ... ④

Reinventing steel every day.

The MCL laboratories provide the foundations for the development of innovative steels for specific applications. A wide range of optimisation processes are available depending on customer requirements:

- Improving material properties such as maximum strength or toughness and physical properties such as thermal conductivity and expansion
- Cost reduction through resource efficiency in the manufacturing process and shorter process chains, e.g. for novel age-hardening steelsf
- Design of steels that open up new fields of application

We make steel manufacturing more efficient and environmentally-friendly.

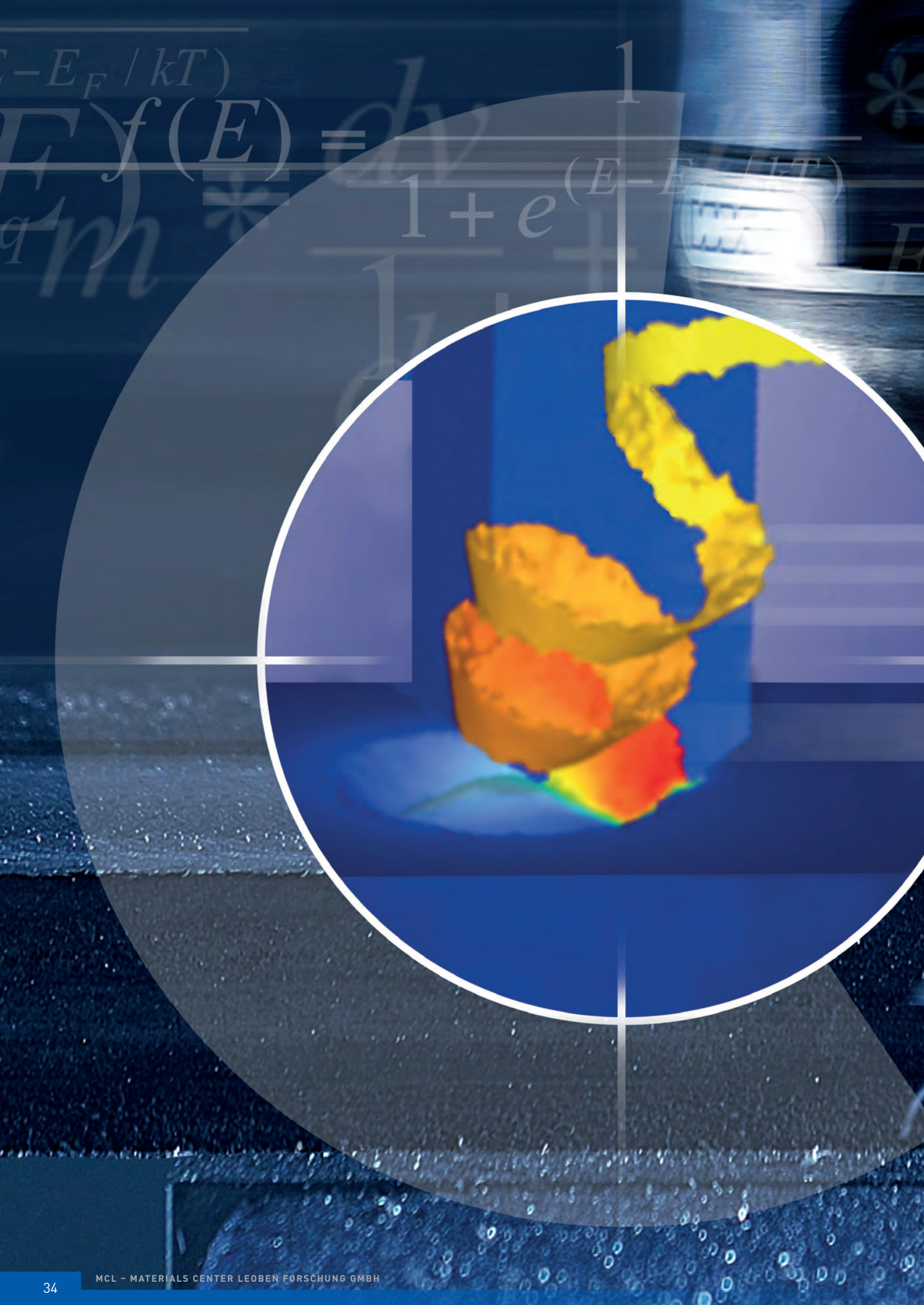
The focus in the further development of processing chains for steels and steel composites is on:

- Modification of steels aimed at optimising their processing behaviour
- Simulation-based optimisation and shortening of process chains in terms of production efficiency, quality and resource use
- Support of intelligent production control concepts using physically-based process models

Our customers and partners are changing the world.

MCL provides fundamentals, simulations and experimental results for

- Weight optimised components for extreme load conditions, e.g. for generator parts or rail vehicles
- Customised solutions for advanced inhomogeneously structured steel products, e.g. novel material concepts for rail switch points or tyre protection chains for utility vehicles in the steel industry
- Innovative design of high-strength steels, e.g. tool steels for stamping and fine blanking or high-performance steels for roller bearings
- New material and process concepts designed to reduce manufacturing steps, e.g. new precipitation hardening steels for high-performance automotive components




TOOLS
INNOVATED BY MCL
TOOL
WE INNOVATE MATERIALS
www.mcl.at

Tools

PROCESSING BEYOND LIMITS.

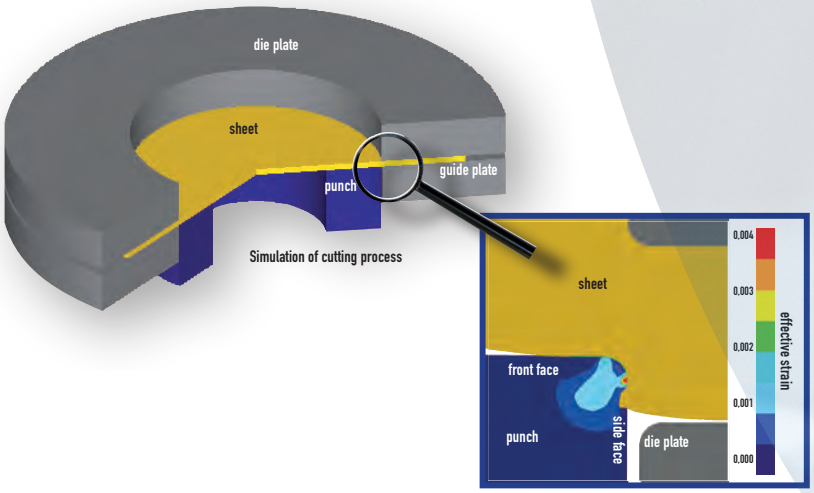
Tools are both a key innovator as well as cost factor in industrial production. The interaction between tool and workpiece always involves contact of different materials under extreme conditions. The goal of MCL's materials research is to extend tool life and efficiency, making manufacturing processes more cost-efficient, and opening up entirely new methods of production. This creates the basis for using innovative tool developments to process new materials and design new shapes – from small and smallest dimensions to the largest scale.

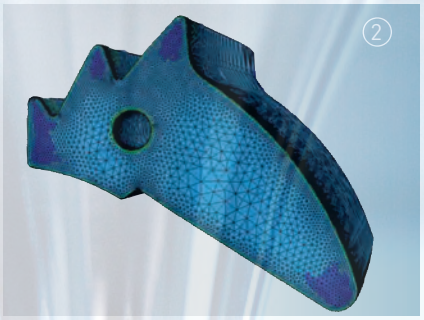
Any change in a material's form or internal structure also requires profound changes in the manufacturing process – whether a material is suitable for an application or not often depends on the tool used for shaping it. With its expertise in high-strength tool materials, MCL offers its development, simulation and testing services wherever two different materials come into contact in the manufacturing process. This places MCL on track to achieve its ambitious goal of becoming the world's leading center for tool technology and production.

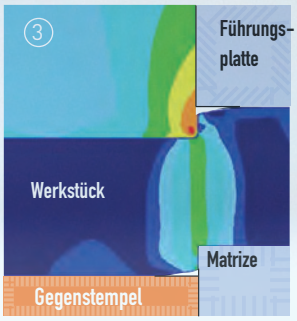
Ongoing innovation

MCL collaborates with partners to develop innovative tool materials and coatings based on the characterisation of material structure and properties:

- Material development
  - Tool steels
  - Steels with specific physical properties
  - Hard metals
  - Nickel and carbon-based tool materials
  - Hard and tribological coatings
- Characterisation of material structures and material properties



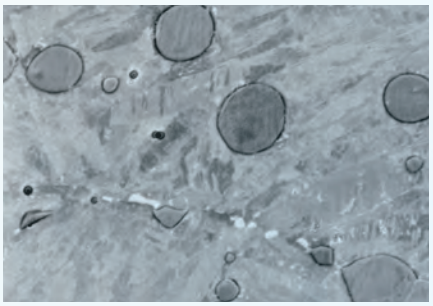




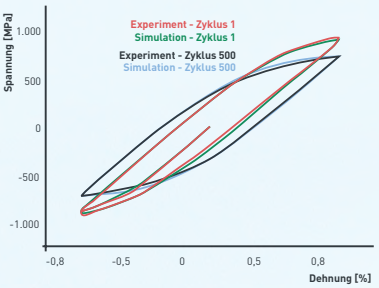
① Part of belt tensioner produced by fine blanking

② FE model of a fine blanking punch

③ 2D view of stresses arising in the workpiece and in the tool during fine blanking



High-resolution SEM microstructure image of a high-carbide high-speed steel



Modelling of cyclic material behaviour (comparison simulation / experiment)

We understand tools inside out.

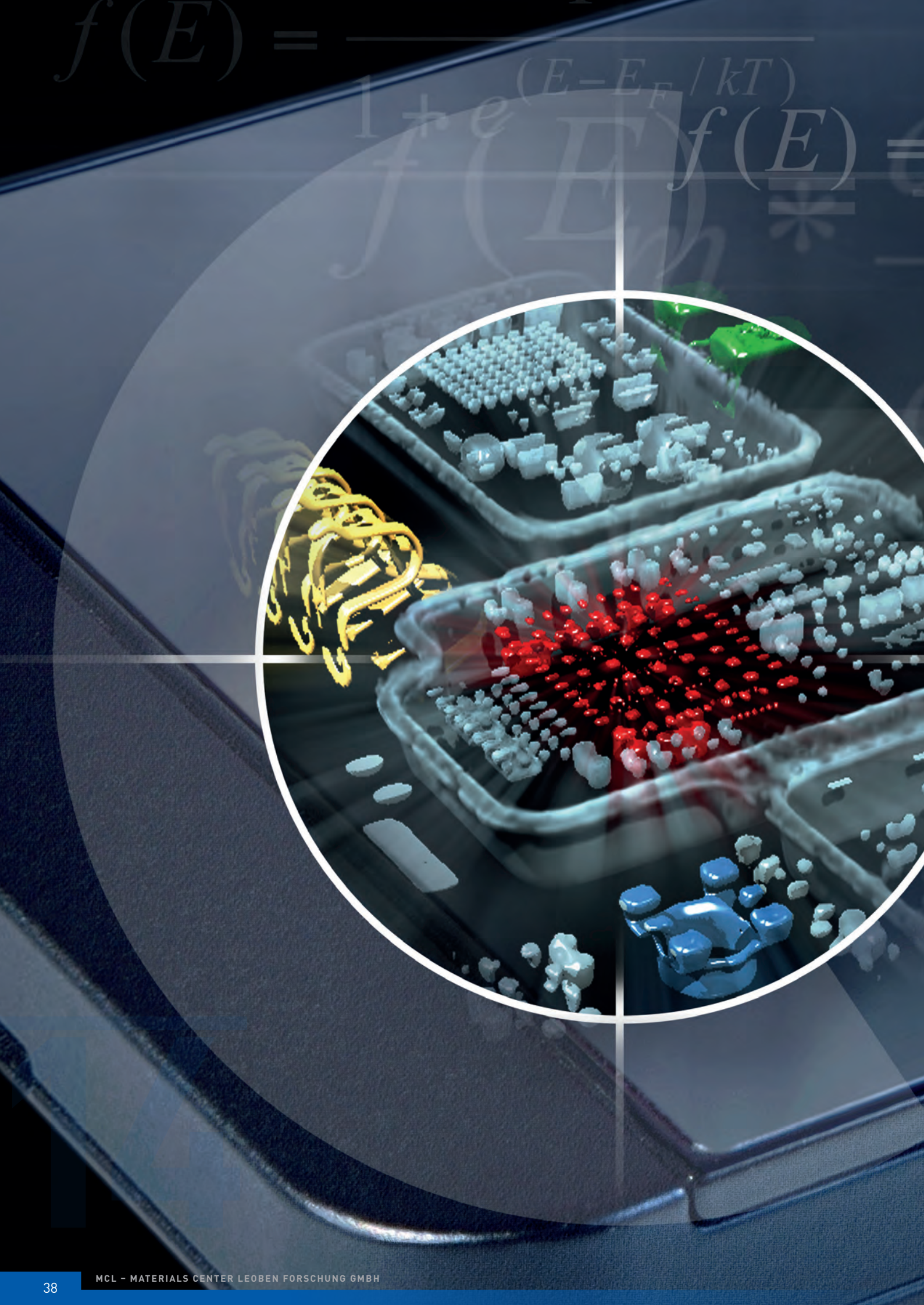
With our many years of experience, MCL can simulate the behaviour of all types of tools to their physical limits. This enables reliable load calculations and predictions of service life which in turn create the basis for the efficient planning of process chains and innovative methods of tool optimisation. MCL also has the methods and equipment needed to record the necessary simulation data:

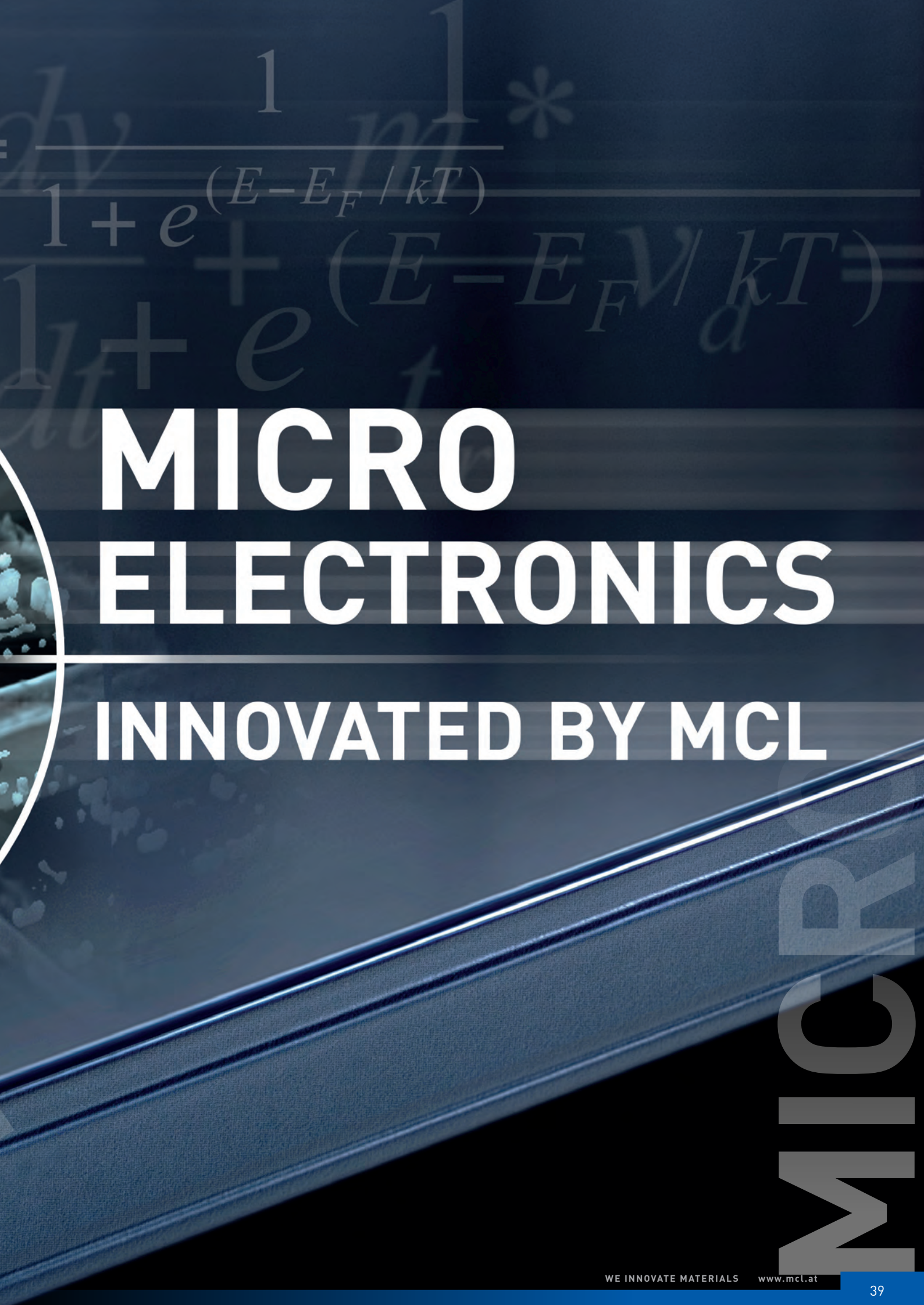
- Knowledge based design of high-performance tools, including material selection
- Damage analysis and calculation of tool life
- Shortening of process chains and cycle times
- Simulation of in-service tool behaviour for
  - die casting tools
  - forging tools
  - cold working tools
  - turning, stamping and drilling tools, including inserts
  - fine blanking tools
  - tunnel drills

The tools of our customers and partners are shaping the world.

MCL provides fundamental research, simulation and experimental results that enable our customers and partners to manufacture tools that redefine the possibilities of production processes.

- PCB micro drills through to tunnel drills of several meters in diameter
- Opening up new manufacturing possibilities through the use of hard metals
- Development of sophisticated characterisation and testing methods for materials with strengths of more than 8000 MPa, even at elevated temperatures

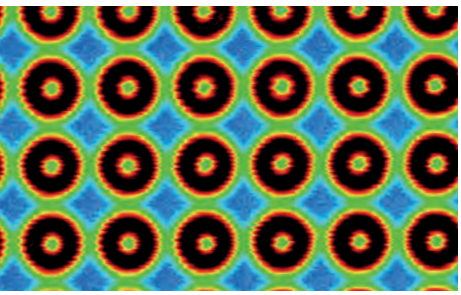



MICRO
ELECTRONICS
INNOVATED BY MCL
MICR

Microelectronics

PERFECTION IN MINIATURE

Ever more functions and higher performance packed into ever smaller devices: that's where microelectronics is heading. This involves hugely varied classes of materials meeting in small spaces and ultra-thin layers, and under increasingly extreme conditions. Mechanical, electrical and thermal stresses on material composites have an increasing impact on the durability and security of microelectronic devices whose range of functions is also expanding through the integration of modern sensors. MCL combines materials knowledge, process technology, analysis and simulations to contribute to ongoing innovation.



Materials research at the nano and micrometer scale is becoming ever more important. It helps guarantee the performance and reliability of microelectronic components in order to manufacture new functional sensor systems. By miniaturising electronic components, whilst simultaneously increasing their functional range, the mechanical, thermal and electrical stresses on the materials involved continue to grow, and may eventually lead to the failure of the component. At the same time, nanomaterials are opening up new applications. Research at MCL ensures that innovative and highly reliable components can be implemented quickly, thus reducing the associated development costs.

Step by step to perfection

MCL has an extensive range of methods and wide-reaching knowledge of process technology in the manufacture of electronic components. We offer two different approaches to provide our partners and clients with the best possible assistance:
We support industrial processes by determining the stresses to which materials and components are exposed during manufacturing. This includes, for example, examining the development of internal stresses and how they are related to the design of the component using complex process simulations.
For joint process and material developments, MCL has access to a process chain for developing gas sensors on Si chips at its site in Leoben and at a cooperative site in Vienna. Here the focus is on innovative materials for sensor technology and their manufacture using CMOS-compatible technologies.

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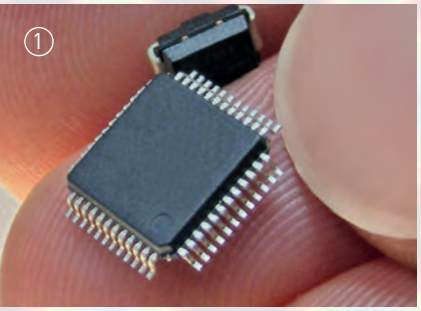
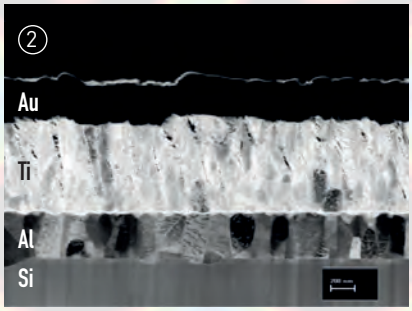


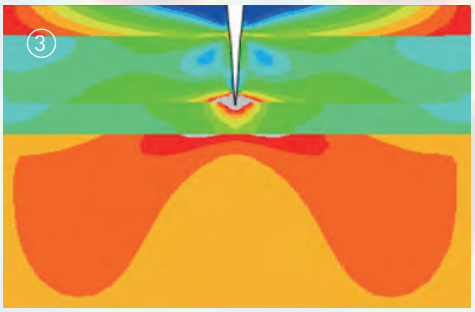


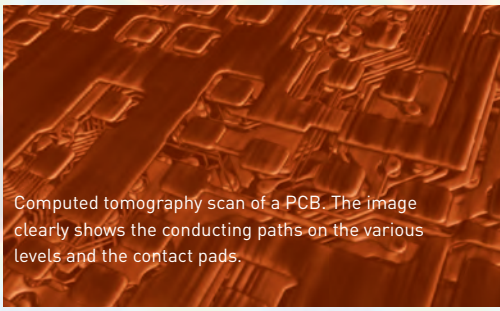
From structures and properties in the nanometer range to the performance of electrical devices

① Microchip

② Layer sequence of a back electrode

③ Simulation of crack growth in the layers of an electronic component





Computed tomography scan of a PCB. The image clearly shows the conducting paths on the various levels and the contact pads.

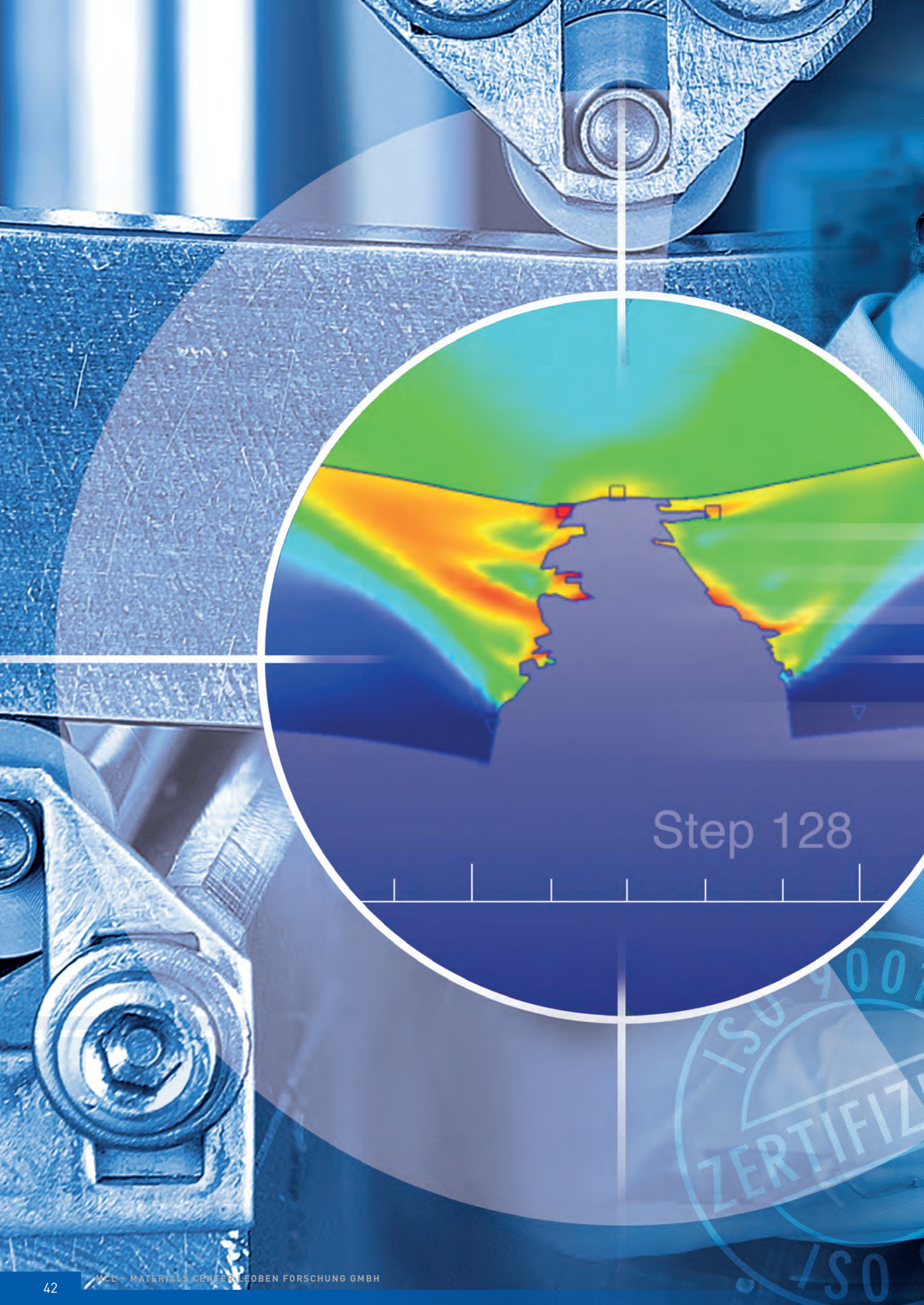
- Supporting technologies:
  Packaging and embedding | Bonding | Through-silicon vias | Process modelling of mechanical and thermal loads for design optimisation

- Technologies on site:
  Spray pyrolysis | Process chain for thin-film and nanowire gas sensors on 8 inch wafers | Structuring

Nanosensors for microelectronic components

MCL is coordinating an EU project with 17 partners aimed at integrating nanosensors into microelectronic components. The primary objective is to develop extremely small sensors for integration into computer chips. Innovations such as these could be used in smartphones for example, to warn participants in outdoor sports of dangerously high ozone levels, city dwellers of high levels of particulate matter, farmers of gases in silos, or sunbathers on the beach of dangerous exposure to UV radiation. Nanosensors also open up new possibilities in building technology: networks of infrared sensors can locate the source of a fire and indicate the exact location of potential victims. Nanosensors also make it possible to control air conditioning systems based not only on room temperature but also on the CO2 concentration, helping to make them more energy-efficient.

MICRO


Step 128


SERVICES
INNOVATED BY MCL
SERVICE

Services

EXPERTISE AND KNOW-HOW IN THE SERVICE OF RESEARCH AND DEVELOPMENT

MCL's core service offerings include characterising materials and components in terms of their structure and microstructure, determining the mechanical and physical properties of materials, developing material models for simulations as well as finite-element-simulations, damage analysis, and advice on the choice of materials. MCL's key advantage lies in its combination of experimental laboratory analysis with calculations and simulations, state-of-the-art technical facilities, and wide-ranging specialist knowledge of the most diverse range of materials. MCL has the expertise and experience required to provide scientifically sound results and targeted support in practical material, process and product development.

MCL offers a variety of laboratory analyses and complex services such as damage analysis or materials advice, in addition to materials, components and process simulations.

The Metallography Laboratory offers the following fields of expertise:

- Microstructure characterisation of metallic/ceramic materials, composites and components
- Determination of cleanliness level or grain size according to standard methods
- Hardness testing from low to high loads
- Profilometry surface analysis, e.g. surface roughness
- Mobile metallography testing on site

The Physical/Chemical Laboratory offers the following fields of expertise:

- X-ray phase and structure analysis, e.g. determination of retained austenite
- X-ray texture analysis
- X-ray analysis of process or service-induced residual stresses and residual stress depth profiles
- Determination of phase transformation temperatures
- Measurement of time-temperature transformation and precipitation diagrams
- Chemical materials analysis
- Measurement of carbon and nitrogen depth profiles and other chemical depth profiles
- 3D imaging using high-resolution computed tomography

The Electron Microscopy Laboratory offers the following fields of expertise:

- Characterisation of surfaces, fracture surfaces and metallographic specimens using scanning electron microscopy
- Materials analysis including 3D microstructure tomography using SEM-FIB-technology
- Target preparation of TEM thin films or atom probe specimens for subsequent high-resolution analysis
- Characterisation of local electronic and magnetic properties and surface morphology using scanning probe microscopy
- Damage characterisation

Analysis, simulation and support designed to find solutions for the development of materials and products, and remedying damage

The Mechanical Testing Laboratory specialises in static and cyclic material tests:

Static materials testing:

- Uniaxial tensile tests from room temperature to 1000°C
- Various other static tensile, compression and bending tests
- Fracture toughness tests (KIC, J-integral and CTOD) from -150°C to 500°C
- Notch-bar impact tests

Cyclic materials testing:

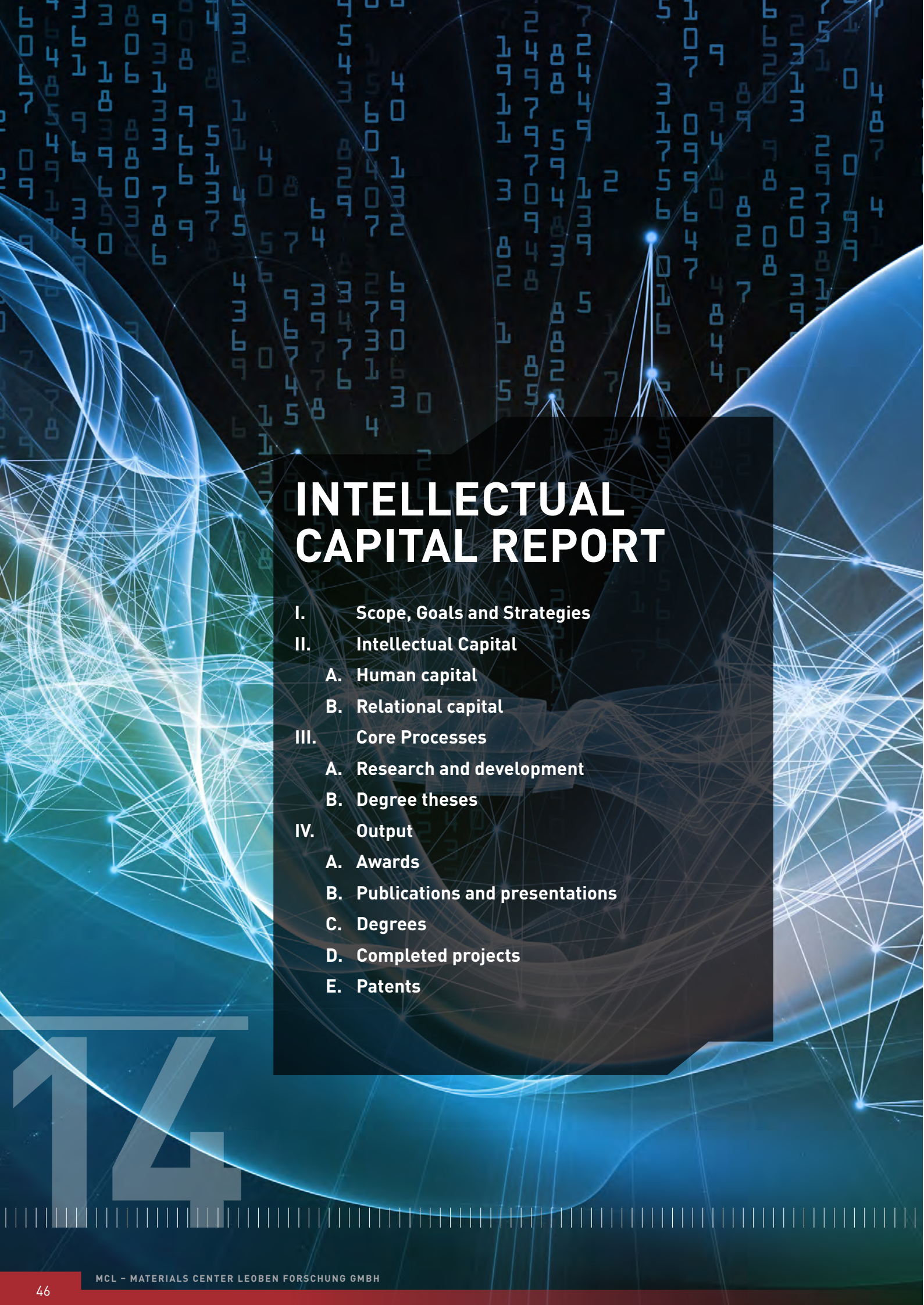
- Uniaxial low cycle fatigue tests on metallic materials from -150°C to 1000°C
- Multiaxial cyclic tests on metallic materials from room temperature to 1000°C with integrated gas quenching
- S-N curves from -150°C to 900°C
- Fracture mechanical tests (crack growth behaviour, determination of threshold values)

The Heat Treatment Laboratory offers the following fields of expertise:

- Standard and special vacuum hardening with controlled high-pressure gas quenching
- Tempering and annealing under vacuum, inert gas or atmospheric conditions
- Deep freezing to -180°C with integrated heating up to 600°C
- Low-pressure carburising of components and specimens
- Plasma nitriding and plasma oxidation of steel materials

The Modelling and Simulation team offers the following fields of expertise:

- Simulation services for development and design
- Damage tolerant design
- Thermomechanical loading
- Process chain simulation
- Modelling of complex material behaviour



INTELLECTUAL CAPITAL REPORT

14

Intellectual Capital Report

I. Scope, Goals and Strategies

Knowledge and expertise are the key factors for the sustainable success of research institutions. The Intellectual Capital Report is designed to provide an overview of MCL's intellectual capital and research outcome. The key indicators in this context are scientific publications, human resources and international networks. Other important factors are output and impact, which are reflected in the number of completed projects or patent applications.
In addition to increasing its scientific excellence, MCL strives to gain better visibility at the international level over the coming years. Various measures have been and will be implemented to achieve this goal:

- MCL defines and launches COMET projects involving new international partners from science and industry.
- Projects with new international partners can be started following successful participation in calls for proposals under international funding programmes.
- Greater cooperation with international scientific partners, such as KTH in Stockholm, is being driven forward in order to strengthen the partner network.
- The International Scientific Advisory Board was established to enable renowned international scientists to critically assess the MCL strategy.
- More MCL employees are taking up positions on international committees.
- The drive to employ more international staff is being continued.
- The organisation and hosting of international conferences enables MCL employees to present their own expertise, to enter into contact with excellent international scientists and to discuss opportunities for cooperation.
- MCL employees are being given the support needed to allow them to take part in international conferences and undertake research abroad.
- Greater attention is being paid to how MCL publications are perceived externally.

II. Intellectual Capital

A. Human capital

Development

On the one hand, the number of doctoral students at MCL decreased in 2014 due to the completion of a number of projects from the first COMET funding period. On the other hand, the number of employees increased further and several doctoral theses were launched in the non-COMET area. The largest increase in staff in 2014 was recorded in the field of microelectronics. The number of MCL employees climbed from 135 in 2013 to 146 as at 31 December 2014. The full-time equivalent rose from 106 to 113.

By the end of 2014, MCL employed 28 international staff members from 14 different countries. This represents 19% of the workforce. Our international employees bring significant benefits to MCL, and their collective experience adds greatly to MCL's range of expertise.

Over 500 additional employees of our company and scientific partners are working on projects in the COMET Programme. With a total of around 600 staff, the COMET Programme thus offers enormous potential for taking on highly complex scientific challenges.

Personnel at MCL/MPPE 2014

as of: 31/12/2014

	Employees		
	male	female	total
Research	**96**	**27**	**123**
Scientific management	1	0	1
Key scientists	14	1	15
Senior scientist	17	6	23
Junior scientist	64	20	84
Administration	**0**	**10**	**10**
Technicians / Skilled staff	**10**	**3**	**13**
Total MCL	**106**	**40**	**146**

Personnel at COMET Partners 2014

Company partners	261	28	289
Scientific partners	180	32	212
Total	**441**	**60**	**501**

MCL generally seeks to offer its employees an attractive working environment, including tailored continuing education and training measures and a high level of flexibility to ensure a sound work-life balance.

Gender mainstreaming

The proportion of female employees at MCL increased further in 2014. As of 31 December 2014, women accounted for 27% of the total workforce and around 22% of scientific employees. The proportion of women working in the microelectronics division was significantly higher and reached 50%, taking into account technicians and students.

MCL is making every effort to continue to increase the number of female employees over the long term, for example by organising a range of activities such as school visits designed to encourage girls to consider careers in science and engineering.

The increasing number of female employees, and the generally low average age of all staff members, is leading to increasing demand for flexible working hours in order to accommodate child care, both amongst male and female staff. MCL offers flexible working for all employees with caregiving responsibilities. Flexible working schemes are continuously being developed to ensure MCL remains an attractive employer for male and female researchers with young families.

Qualification measures and personell development

The MCL qualification programme is designed to achieve the maximum possible overlap between the interests of the COMET Center and the professional skills and thematic interests of its staff. The qualification programme includes general measures to improve scientific and technical skills, as well as qualifications relevant to individual employees.

Young scientists are involved in research projects at an early stage in their training, and can undertake research as part of their bachelor's, master's and doctoral qualifications. MCL also gives its employees the opportunity to undertake research with national and international research partners, and to take part in national and international conferences. In addition to subject-related training, measures are available for MCL employees to improve other skills including scientific writing, communication and negotiation, project management and team leadership. The staff are also regularly trained in occupational safety and health.

MCL also helps employees organise their professional environment so that they can complete their habilitation.

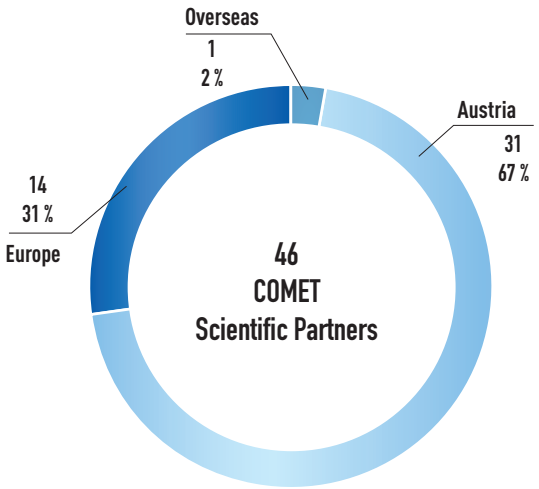
B. Relational capital

COMET – Scientific Partners

A large number of scientific partners have joined the COMET Programme over the past few years to work jointly on the solution of complex research problems. A total of 46 scientific partners from 24 research institutions and universities were involved in COMET Phase II until 2014:

- Aalto University, Department of Materials Science and Engineering
- Academy of Science of the Czech Republic , Institute of Physics of Materials
- ARMINES
- Austrian Foundry Research Institute (Österreichisches Gießerei-Institut)
- Bay Zoltan Foundation for Applied Research
- Erich Schmid Institute for Materials Science, Austrian Academy of Science
- Ecole Nationale Supérieure de Céramique Industrielle (ENSCI), Groupe d'Étude des Matériaux Hétérogènes (GEMH), Limoges
- Graz University of Technology with
  - Institute of Lightweight Design
  - Institute of Materials Science and Welding
- JOANNEUM RESEARCH Forschungsgesellschaft m.b.H
- Karl Franzens University Graz with Institute of Physics
- Forschungszentrum Karlsruhe GmbH, Eggenstein Leopoldshafen (KIT)
- LKR Leichtmetallkompetenzzentrum Ranshofen GmbH
- Max-Plank-Institut für Eisenforschung GmbH
- Max-Plank-Institut für Kolloid- und Grenzflächenforschung
- Montanuniversität Leoben with
  - Chair of Nonferrous Metallurgy
  - Chair of Thermal Processing
  - Institute of Mechanics
  - Institute of Physics
  - Chair of Subsurface Engineering
  - Institute for Structural and Functional Ceramics
  - Institute of Material Science and Testing of Plastics
  - Chair of Mechanical Engineering
  - Chair of General and Analytical Chemistry
  - Chair of Functional Materials and Materials Systems
  - Chair of Ceramics
  - Chair of Casting Research
  - Chair of Physical Metallurgy and Metallic Materials
  - Chair of Materials Physics
  - Chair of Metallurgy
  - Chair of Simulation and Modelling of Metallurgical Processes
  - Chair of Physical Chemistry
  - Chair of Metal Forming
  - Chair of Applied Mathematics
- Royal Institute of Technology, Department of Materials Science of Engineering
- Slovak Academy of Science with
  - Institute of Physics
  - Institute of Inorganic Chemistry

- University of Vienna Researchgroup Physics of Nanostructured Materials, Faculty of Physics
- Universite d' Orleans, Laboratoire PRISME
- University of Maribor, Faculty of Mechanical Engineering
- University Paderborn, Lehrstuhl für Technische Mechanik
- University of Wollongong
- Vienna University of Technology with
  - Institute of Chemical Technologies and Analytics, Faculty of Technical Chemistry
  - Institute for Mechanics of Materials and Structures
  - Institute of Materials Science and Technology, Faculty of Mechanical and Industrial Engineering
- VIF - Das Virtuelle Fahrzeug Forschungsgesellschaft mbH



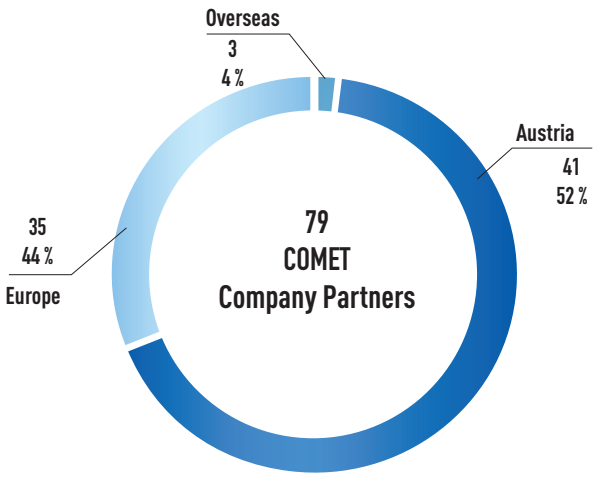
Number and origin of scientific partners

COMET – Company Partners

The majority of the company partners from COMET Phase I also participate in the second funding period. 11 new company partners joined the COMET Programme in 2014. A total of 79 national and international companies were involved in COMET Phase II until 2014:

Agie Charmilles SA
Almatis GmbH
Alstom Transport Deutschland GmbH
AMAG Casting GmbH
AMAG Rolling GmbH
AMSC Austria GmbH
Andritz AG
Andritz Hydro GmbH
AT&S AG
AVL List GmbH
Bochumer Verein Verkehrstechnik GmbH
Böhler Edelstahl GmbH & Co KG
Böhler Schmiedetechnik GmbH & Co KG
Böhler Schweißtechnik Austria GmbH
Böhler Schweißtechnik Deutschland GmbH
BOLIDEN Commercial AB
Bruker AXS Analytical X-Ray Systems GmbH
Buderus Edelstahl GmbH
Calderys France SA
Ceratizit Austria Gesellschaft mbH
Ceratizit Deutschland GmbH
Ceratizit Luxembourg S.a.r.l.
Continental Automotive GmbH
Deutsche Edelstahlwerke Gmbh
Eisenwerk Sulzau-Werfen R. & E. Weinberger AG
Epcos OHG
Europipe GmbH
Faively Transport Witten GmbH
Federation for International Refractory Research and Education
Fritz Schiess AG
Georg Fischer Automotive AG
Gutehoffnungshütte Radsatz GmbH
Hegenscheidt MFD GmbH & Co KG
Infineum International Limited
Kerneos SA
Komptech Umwelttechnik GmbH
Konrad Forsttechnik GmbH
Krenhof Aktiengesellschaft
LUK GmbH &CoKG
MAGMA Gießereitechnologie GmbH
MIBA Gleitlager GmbH
MIBA Sinter Austria GmbH
MTU Aero Engines GmbH
Nemak Linz GmbH
ÖBB Infrastruktur AG
OMV Exploration & Production GmbH
Panasonic Industrial Devices Materials Europe GmbH
Pewag Austria GmbH
Plansee SE
Platit AG
Pyrotek High-Temperature Industrial Products Inc.

RAG - Rohöl-Aufsuchungs AG
RHI AG
Rio Tinto Alcan
Robert Bosch GmbH
Sandvik Mining and Construction GmbH
Schoeller-Bleckmann Edelstahlrohr GmbH
Siemens Aktiengesellschaft Österreich
Siemens VAI Metals Technologies GmbH & Co
SKF Österreich AG
Stadler Pankow GmbH
Stahl Judenburg GmbH
Sucotec AG
TAG s.r.l.
Tata Steel Ijmuiden B.V.
Thales Corporate Services
ThyssenKrupp Presta AG
TIWAG Tiroler Wasserkraft AG
Vallourec Group
voestalpine Edelstahl GmbH (former: Böhler Uddeholm AG)
voestalpine Grobblech GmbH
voestalpine Schienen GmbH
voestalpine Stahl Donawitz GmbH & Co KG
voestalpine Stahl GmbH
voestalpine Tubulars GmbH & Co KG
voestalpine VAE GmbH
Voith Turbo GmbH & Co.KG
Welser Profile Austria GmbH
W. Blösch AG



Number of company partners by origin

Non-COMET partners

Nationally funded programmes

In addition to ongoing projects, MCL launched two new nationally funded projects in 2014 under the "Production of the Future" programme ("TheLED" and "Real Nano"), which are also coordinated by MCL. Another project under the "Competence Headquarters" programme was started in cooperation with an Austrian company partner.

MCL cooperated with a range of partners in a total of 11 projects funded under various national programmes (e.g. "Intelligent Production", "Production of the Future, "FWF", etc.) in 2014. A wide variety of national funding programmes are available for different target groups, so that MCL's industrial partners in this area range from medium-sized to large enterprises.

Programmes with international funding

MCL participates in the two ENIAC projects "POLIS" and "eRamp", which were launched in 2014. These projects involve 21 and 28 national and international project partners, respectively, from industry (e.g. STMicroelectronics, EVG Group, Infineon Technologies, etc.) and science (e.g. CEA-Leti, University of Edinburgh, IMEC, etc.), offering MCL the opportunity to increase its expertise and international visibility and further expand its partner network.

In 2014, MCL also coordinated the project "MSP - Multi Sensor Platform for Smart Building Management", which started in 2013 and includes 17 partners from industry, universities and research institutions in 6 European countries, e.g. AMS AG, EV Group, Siemens AG, Samsung R&D Institute UK, Fraunhofer, the University of Cambridge and the University of Oxford.

MCL also participated in the project "EasyForm - Laser assisted metal spinning for an efficient and flexible processing of nickel and titanium alloys" working together with 5 project partners from industry and non-university research institutions.

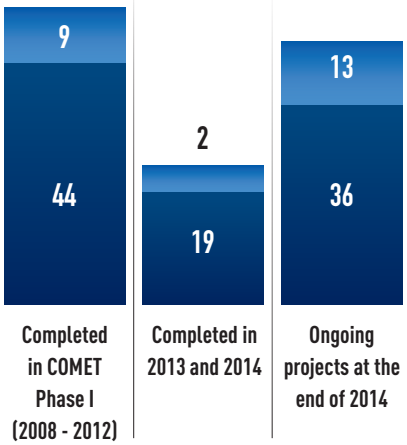
Unfunded non-COMET projects

MCL again succeeded in winning many new customers during 2014, which were involved in both smaller contracts as also larger projects. New regular customers were established in the unfunded project sector, as well as for laboratory, computational and consultancy services. While the list of regular customers is dominated by large enterprises, the smaller assignments come from many smaller and medium-sized businesses. All in all, MCL has a broad customer base of some 150 company partners in the unfunded sector.

III. Core Processes

A. Research and development

MCL was able to start 14 new COMET projects in 2014, creating a sound basis for the coming years. In the past financial year MCL also successfully concluded 14 COMET projects from the first funding period. A total of 49 projects were ongoing at the end of 2014.

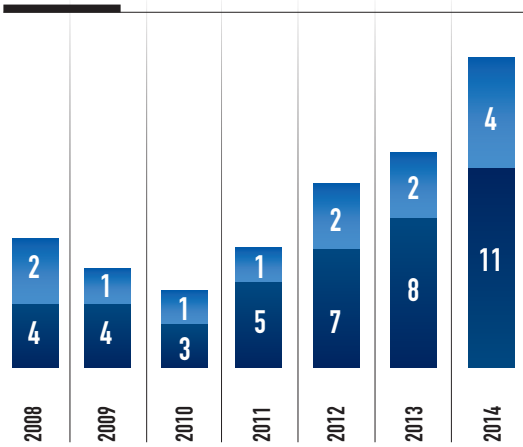


Number of COMET research projects

Strategic projects
Company projects

In the non-COMET area, MCL worked on a total of 11 nationally funded and 4 internationally funded projects in 2014. MCL was also extremely successful in national project applications:

- 2014 saw the start of the two projects "TheLED" and "Real Nano", which are funded under the national "Production of the Future" programme. Both projects are coordinated by MCL.
- Another nationally funded project was started under the "Competence Headquarters" programme. The project is carried out in cooperation with an Austrian company partner.
- The two ENIAC projects "POLIS" and "eRamp" approved in 2013 started in the first half of 2014.
- MCL again successfully participated in national calls in 2014. Two projects under the "Production of the Future" programme have been approved and are scheduled to start in 2015.

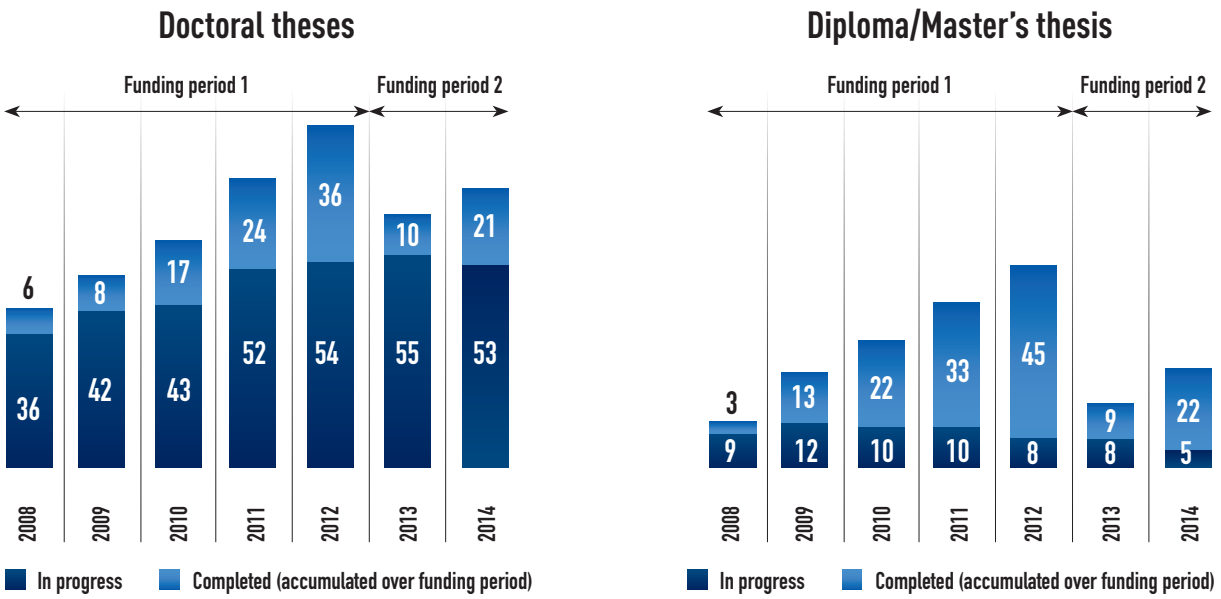


Number of ongoing Non-COMET research projects

international Non-COMET projects
national Non-COMET projects

B. Degree theses

The degree theses (bachelor's, master's and doctoral theses) completed or in progress at MCL are making an invaluable contribution to the training of young scientists, ensuring that both business and science enjoy access to a pool of highly qualified personnel with practical know-how.



Doctoral theses as part of COMET projects:

During 2014, a total of 11 doctoral theses were successfully completed and another 9 started as part of COMET projects. 53 doctoral theses were in progress at MCL by the end of 2014. A total of 21 doctoral theses were completed in the first two years of the second funding period. In comparison, 8 doctoral theses were concluded during the first two years of the first funding period, and 36 over the entire first COMET funding period.

Diploma/Master's theses as part of COMET projects:

A total of 22 diploma/master's theses were completed as part of COMET projects in the first two years of the second funding period. Another 5 theses were in progress by the end of 2014. In comparison, 13 diploma/master's theses were successfully completed during the first two years of the first funding period and 12 theses were in progress by the end of 2009.

Doctoral, Diploma/Master's theses as part of non-COMET projects:

The increase in the number of funded non-COMET projects has led to a corresponding increase in the number of degree theses in this area. One doctoral thesis was successfully completed in 2014. Another 7 doctoral theses and 5 diploma/master's theses were in progress in the non-COMET area by the end of 2014.

IV. Output

A. Awards and highlights

Association of the Austrian Vehicle Industry awards prizes to DI Florian Summer and Dr. Paul Kainzinger

In 2014 the Association of the Austrian Vehicle Industry presented awards to Master's and doctoral theses of high relevance to the automotive industry for the 30th time.

A total of 11 awards with a total of 28,000 euros in prize money were presented to graduates from the Vienna and Graz Universities of Technology, the University of Linz and Montanuniversitaet Leoben.

We are proud to announce that two researchers from the Chair of Mechanical Engineering at Montanuniversitaet Leoben were among the prize winners:

DI Florian Summer won first prize for his diploma thesis on the tribometric performance of lubricated aluminium-based sliding systems.

DI Dr.mont. Paul Kainzinger won second prize for his doctoral thesis on the fatigue strength of ferritic cast iron with ductile iron, taking special account of size effects under the influence of defects.

The theses were written as part of COMET K2 projects carried out at the Competence Centre for Materials, Processing and Product Engineering (MPPE).

Our congratulations to the prize winners!

The Federation of Industry awards excellence grant to DI Marlene Mühlbacher

DI Marlene Mühlbacher, doctoral student at the Chair of Functional Materials and Materials Systems in a strategic project of the Materials Center Leoben, has received an excellence grant from the Carinthian branch of the Federation of Austrian Industry.

In her doctoral thesis DI Marlene Mühlbacher investigates diffusion mechanisms in barrier layers for microelectronics. Barrier layers serve to prevent the diffusion of copper from the conductors into the semiconductor structures. She uses high-resolution methods such as three-dimensional atom probe tomography and transmission electron microscopy to improve the understanding of these diffusion phenomena. The findings obtained in the thesis will provide the basis for the development of more efficient barrier layers and also significantly contribute to the further miniaturisation of semiconductor components.

DI Marlene Mühlbacher will use her grant to spend a research period at the University of Linköping in Sweden, where she will contribute to a better understanding of diffusion phenomena using the most powerful transmission electron microscope currently available in Europe.

We congratulate her on her successful selection for this grant!

Presentation of the excellence grants of the Carinthian branch of the Federation of Austrian Industry (DI Marlene Mühlbacher in first row, second from left)

Graduate Student Award for DI Angelika Zeilinger

The Spring Meeting of the European Materials Research Society took place in Lille, France, from 26 to 30 May 2014.

DI Angelika Zeilinger received the Graduate Student Award for her doctoral thesis entitled "Cross-sectional X-ray nanodiffraction as a powerful tool to reveal structure-property relationships in nanocrystalline coatings".


EUROPEAN MATERIALS RESEARCH SOCIETY
YOUNG SCIENTIST AWARD
presented to
Angelika Riedl
in recognition of an outstanding paper contributed to the
2014 E-MRS SPRING MEETING
Symposium G
Carbon- or Nitrogen-containing Nanostructured Thin Films

In her doctoral thesis DI Angelika Zeilinger develops microscale and nanoscale methods to characterise the structure and properties of thin films. The research is carried out as part of the COMET K2 project "Advanced techniques for characterizing structure and residual stresses in multilayered thin films and engineering components" in collaboration with the Chair of Functional Materials and Materials Systems and the Chair of Materials Physics.

We congratulate DI Angelika Zeilinger on winning the award!

Johann Puch Innovation Award for DI Philipp Bergmann

DI Philipp Bergmann, a mechanical engineering graduate from Montanuniversitaet Leoben won first place in the Johann Puch Innovation Award 2014.

The prize is awarded annually for innovative and practice-oriented degree theses in memory of the great Austrian automotive pioneer Johann Puch. This year the award focused on three essential aspects of sustainability: sustainable production processes and materials, alternative drive systems and sustainability of the overall vehicle.

In his diploma thesis, DI Philipp Bergmann developed a method for testing and visualising frictional behaviour and lubricant film formation of journal bearings in engines. His thesis won the award against stiff competition from Austria, Slovenia, Hungary, Germany and Switzerland.

DI Philipp Bergmann wrote his diploma thesis as part of a COMET K2 project of the Competence Centre for Materials, Processing and Product Engineering (MPPE).

We congratulate DI Philipp Bergmann on this award!

SIMUFER Award for Dr. Marco Deluca

Dr. Marco Deluca, research assistant at Materials Center Leoben Forschung GmbH, received the SIMUFER Award for the best success story at the COST MP0904 Action Showcase on "Single- and Multiphase Ferroics and Multiferroics with Restricted Geometries".

COST is an organisation of the European Union which provides Actions to promote the transfer of scientific know-how, further education and networking in a range of topics. Dr. Marco Deluca was exceptionally successful in COST Action MP0904 and was thus nominated for the prize by the relevant International Advisory Board. Action MP0904 is a COST-funded project supporting the collaboration between institutes working in the field of ferroelectric materials in different European countries.

Dr. Marco Deluca succeeded in launching a number of new collaborations with European scientific partners in the course of Action MP0904 (April 2010 – May 2014). The scientific work led to 10 publications in SCI indexed journals which have been cited 55 times to date.

We congratulate Dr. Marco Deluca on winning this prestigious award!

2nd prize for Dr. Sören Röhrig for his doctoral thesis at the 2nd Annual Meeting of the Austrian Ceramic Society


Urkunde

wird Herrn Sören Röhrig

für die Dissertation

Elektrothermische Analyse von planaren PTC-Heizern

der 2. Preis zuerkannt

The 2nd Annual Meeting of the Austrian Ceramic Society (AuCerS) took place at Graz University of Technology on 12 February 2014.

The Annual Meeting was attended by numerous industry representatives, e.g. from CARRD GmbH, EPCOS OHG, IBS Austria, LITHOZ GmbH, SKF Österreich AG, Treibacher Industrie AG and RHI AG. The topics presented focused in particular on electrical ceramics (varistors, LTCCs, PTCs, capacitors) as also on damage analysis of ceramic structural elements (rolling elements) and ceramic 3D printing.

At the event, representatives of the Austrian Ceramic Society presented prizes for scientific degree theses and publications in the field of ceramics. Dr. mont. Sören Röhrig received second prize for his doctoral thesis on electrothermal analysis of planar PTC heaters. The thesis was written as part of the COMET K2 project A7.8 "Novel functional ceramic structural components – ceramic PTC thermistors ".

MCL congratulates Dr. Sören Röhrig on winning this prize.

„Collaboration in research – the key to success“

Dr. Stefan Marsoner
Manager Materials Technology and Internal & External Services

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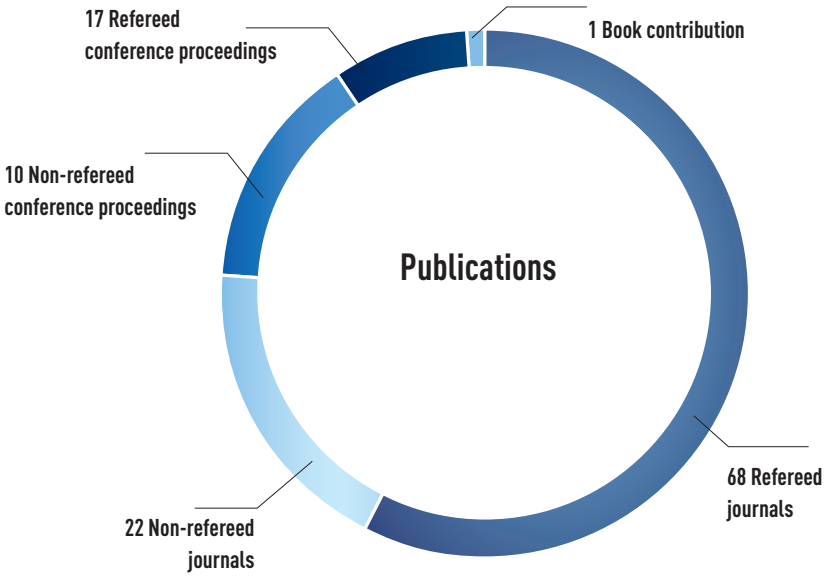
B. Publications and presentations

The majority of scientific papers from the COMET Center were published in refereed journals. The Center's results were also communicated at numerous national and international conferences, workshops and specialist events in the form of oral and poster presentations. The scientists presented their project results at European events relevant to the MCL research areas, as also at conferences in the USA, China, Korea and Japan.



During 2014 the COMET Center used various channels to present its research output:

- 90 papers in specialist journals (of which 68 in refereed journals)
- 87 international conferences, workshops and specialist events
  - 27 papers in conference proceedings (of which 17 in refereed proceedings)
  - 122 oral/poster presentations
- 1 book contribution

The increasing number of projects outside COMET have enabled MCL to produce more publications in this area. Research carried out as part of non-COMET projects led to 6 articles (of which 5 refereed), 1 conference paper (refereed) and 1 presentation in 2014.

Over the past years greater attention has been paid to the external perception of MCL publications. Therefore in 2012 a database was set up to record and access citations of publications relating to MCL projects. The database is used to calculate and track the number of cited publications, the total number of citations, and the h-index of MCL team members. The development of these indicators over the years show a very positive trend, providing evidence of the scientific productivity and the increased impact and visibility of MCL in the scientific community.

C. Degrees

The following doctoral and diploma theses were completed in 2014.

Doctoral theses:

Eßl Werner
Modeling the accelerated cooling process in heavy steel plate production

Horn Andreas
Bruchmechanisches Verhalten von hochfesten Baustählen und deren Schweißverbindungen

Kaiser Robert
Eigenspannungsoptimiertes Richten von Eisenbahnschienen

Lang Peter
Modelling and thermo-kinetic computer analysis of the precipitation sequence of metastable and stable phases in heat treatable aluminium alloys

Maierhofer Jürgen
Damage tolerance and strength increase of drivetrain components

Mikl-Resch Markus
Numerical analysis of the rock cutting and the loading of roock cutting tools

Presoly Peter
Untersuchung der Wirkung von Legierungselementen auf die peritektische Phasenumwandlung in Stählen

Raninger Peter
Characterization and Modeling of the Thermomechanical Fatigue Behavior of Brake Disks for High Speed Trains

Stefenelli Mario
Advanced Diffraction Techniques for Microstructure and Stress Characterisation at Multiple Scales

Steinhauer Stefan
Gas Sensing Properties of Metal Oxide Nanowires and their CMOS Integration

Strobl Stefan
New methods for the mechanical characterisation of ceramic rolling elements

Zeilinger Angelika
Synthesis-Structure-Property Relations in Nanostructured Thin Films Determined by Local Characterization Techniques

Diploma / Master's theses:

Distelberger Stefan
FE-Simulation of chip formation in inhomogenous materials

Gehwolf Paul
Numerical modelling of the small scale rock cutting test

Kaltenbrunner Thomas
Accelerated cooling of heavy steel plates – selected aspects of modelling

Krobath Roman
Einfluss der Abkühlbedingungen auf die Bildung von Oberflächenrissen beim Stranggießen eines Nb mikrolegierten Stahls

Loidolt Peter
Cold Deformation and Recrystallization of the Aluminium Alloy 6082

Moder Jakob
Bewertung von Mischreibungsvorgängen in kontraformen Kontakten

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Panzl Gerhard
Ermittlung der Zähigkeitsentwicklung großer Schmiedestücke während der Wärmebehandlung

Petersmann Manuel
Numerical analysis of a multivariant martensitic phase transformation in nanostructured NiTi considering elastic anisotropy

Radlwimmer Harald
Comparison of the aging behavior in industrial and laboratory-made pure aluminium 6xxx-series alloys

Saringer Christian
An optimized biaxial stress temperature measurement for TiAlN based hard coatings

Simunek David
Aufbau einer numerischen Simulationskette zur betriebsfesten Bewertung hochfrequent gehämmerter Schweißverbindungen

Weisz Thomas
Microstructural evolution during homogenization of AA-7075 alloy

Yueting Qian
Creep law identification of several shaped and unshaped refractories

„Creativity, commitment and diligence are essential for turning plans into reality“

Dr. Günther Maier
Manager Materials for Microelectronics

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D. Completed projects

A total of 14 COMET projects were successfully concluded in 2014:

A2.13 High Performance Chains

pewag austria GmbH, voestalpine Stahl Donawitz GmbH & Co KG, Montanuniversitaet Leoben, Austrian Academy of Sciences, Materials Center Leoben Forschung GmbH

A2.15 Alternative Pump Components

Andritz AG, Bruker AXS GmbH, Polymer Competence Center Leoben GmbH, Montanuniversitaet Leoben, Slovac Academy of Science Chemistry, Materials Center Leoben Forschung GmbH

A2.16 Thermo-kinetic quantitative prediction of the metastable and stable phases in aluminum alloys class 7xxx and the dispersoids in 6xxx aluminum alloys

AMAG rolling GmbH, Vienna University of Technology, Materials Center Leoben Forschung GmbH

A2.18 Ab-initio stacking-fault energies of steels

Montanuniversitaet Leoben, Royal Institute of Technology, Kungliga Tekniska Högskolan, Materials Center Leoben Forschung GmbH

A3.12 Process modelling for manufacturing of seamless stainlesssteel tubes (SSST) in special applications and alloys

Schoeller-Bleckmann Edelstahlrohr GmbH, Böhler Edelstahl GmbH & Co KG, Montanuniversitaet Leoben, Materials Center Leoben Forschung GmbH

A3.13 Residual Stresses during the Heat Treatment of Large Forgings

Böhler Uddeholm AG, Buderus Edelstahl GmbH , Böhler Edelstahl GmbH & Co KG, Montanuniversitaet Leoben, Vienna University of Technology, Materials Center Leoben Forschung GmbH

A3.14 Modelling the Thermo-mechanical Material Response of Heavy Steel Plates during Cooling

voestalpine Grobblech GmbH, Montanuniversitaet Leoben, Materials Center Leoben Forschung GmbH

A4.13 Damage Tolerance and Strength Improvement of Railway Axles

Siemens Aktiengesellschaft Österreich, Hegenscheidt-MFD GmbH & Co. KG, Montanuniversitaet Leoben, Austrian Academy of Sciences, Materials Center Leoben Forschung GmbH

A4.14	Reliability of highly stressed ceramic rolling elements – Influence of machining and pre-damage SKF Österreich AG, Technisches Büro für Maschinenbau, DI Rupert Huber, Montanuniversitaet Leoben, Materials Center Leoben Forschung GmbH
A4.15	Insulating refractories and their applications in multilayer lining designs Almatis GmbH, Calderys France SA, Federation for International Refractory Research and Education, Kerneos SA, Pyrotek High-Temperature Industrial Products Inc., RHI AG, Rio Tinto Alcan International Limited, TATA Steel Ijmuiden B.V., Vallourec Group, Montanuniversitaet Leoben, Ecole Nationale Supérieure de Céramique Industrielle, University of Orléans, Materials Center Leoben Forschung GmbH
A4.19 / KP1	Damage in rails and crossings: Simulation, description, prediction and optimization voestalpine Schienen GmbH, voestalpine VAE GmbH, Montanuniversitaet Leoben, Materials Center Leoben Forschung GmbH
A5.11	Experimental and numerical analysis of the rock cutting process and the loading of rock cutting tools Sandvik Mining and Construction G.m.b.H., Montanuniversitaet Leoben, Materials Center Leoben Forschung GmbH
A6.14	Betriebssicherheit von geschweißten hochfesten Pipelines und Druckrohrleitungen Böhler Schweißtechnik Austria GmbH, Böhler Schweißtechnik Deutschland GmbH, EUROPIPE GmbH, BIS VAM Anlagentechnik GmbH, OMV Exploration & Production GmbH, OMV Gas GmbH, PPS pipeline Systems GmbH, TIWAG Tiroler Wasserkraft AG, voestalpine Grobblech GmbH , voestalpine Tubulars GmbH & Co KG, Montanuniversitaet Leoben, Austrian Academy of Sciences, Versuchsanstalt für Maschinenbau an der HTL Innsbruck, Academy of Sciences of the Czech Republic, Graz University of Technology , Materials Center Leoben Forschung GmbH
A6.15	Simulation of in-service and damage behaviour of brake discs for railway bogies Siemens Aktiengesellschaft Österreich, Faiveley Transport Witten GmbH, Montanuniversitaet Leoben, Austrian Academy of Sciences, Materials Center Leoben Forschung GmbH

In the Non-COMET area, a project with a company partner was successfully completed in 2014 in the framework of the Innovation Check Plus.

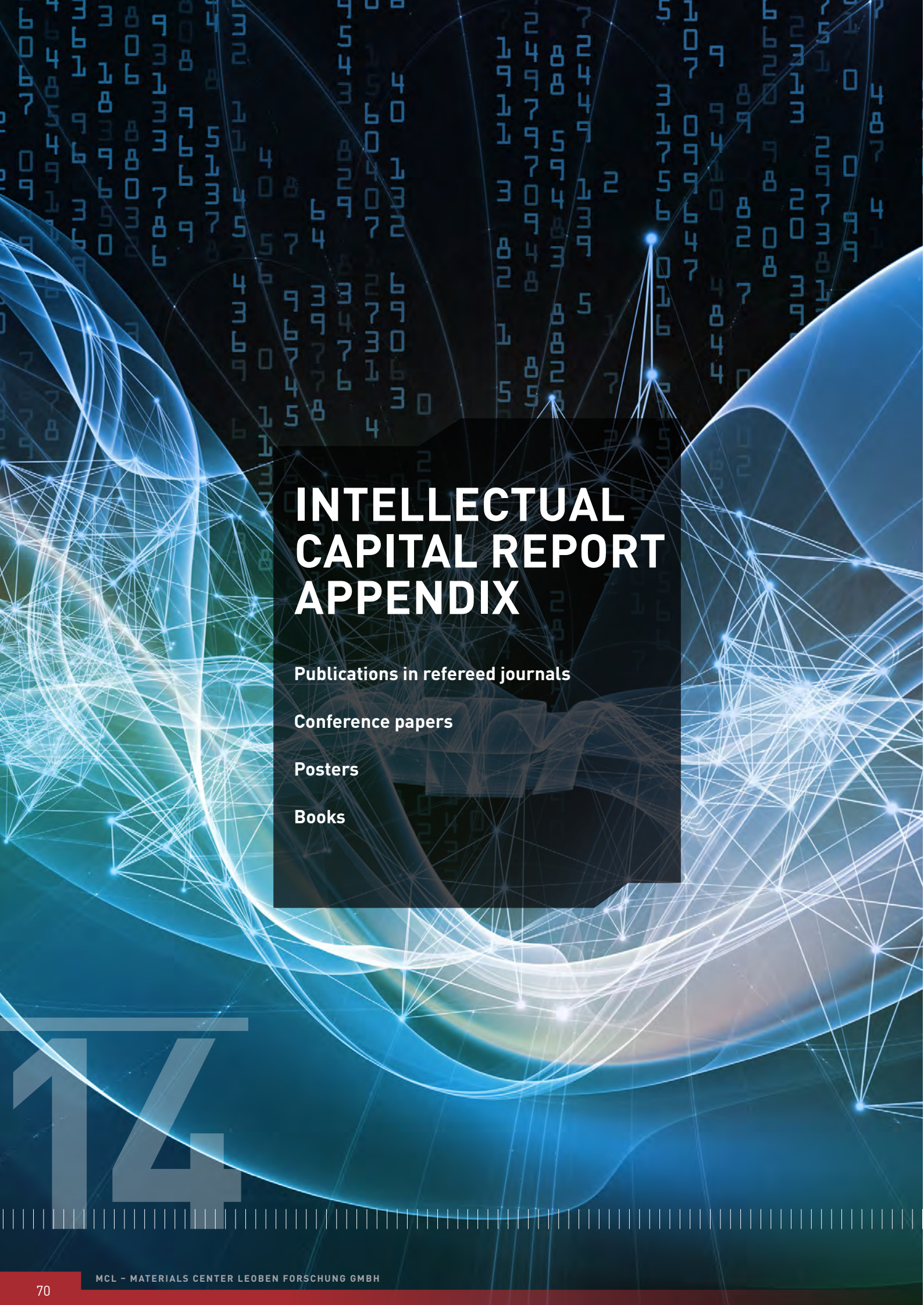
E. Patents

Patents are key indicators of the innovative strength of a competence centre. The focus of the COMET research programme has so far been on establishing fundamental knowledge, but will increasingly shift towards application in the next few years.

MCL and COMET researchers were involved in the following patent applications filed in 2014:

- „Ferritic alloys and methods for preparing the same"; international patent application
- „Vorrichtung und Verfahren für Modellschneidversuch", european patent application
- „Verfahren zum Testen des Materialverhaltens von zwei relativ zueinander bewegten Körpern und Vorrichtung hierfür"; national patent application
- „Verfahren zur Prüfung eines Körpers mit sprödem Materialverhalten"; national patent application

Additional patent applications are in preparation and will be filed in 2015.



INTELLECTUAL CAPITAL REPORT APPENDIX

Publications in refereed journals

Conference papers

Posters

Books

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Appendix

A) Publications in refereed journals

Author Co-Author	Title	Journal	Edition/ Year
Ahmadi, M. R.; Povoden-Karadeniz, E.; Öksüz, K. I.; Falahati, A. & Kozeschnik, E.	**A model for precipitation strengthening in multi-particle systems**	Computational Materials Science	91 (2014) 173-186
Ahmadi, M.R.; Povoden-Karadeniz, E.; Sonderegger, B.; Öksüz, K. I.; Falahati, A. & Kozeschnik, E.	**A model for coherency strengthening of large precipitates**	Scripta Materialia	84-85 (2014) 47-50
Angerer, P.; Lackner, J. M.; Wießner, M.; Maier, G.A. & Major, L.	**Thermal behaviour of chromium nitride/titanium–titanium carbonitride multilayers**	Thin Solid Films	562 (2014) 159-165
Angerer, P. & Strobl, S.	**Equi-penetration grazing incidence X-ray diffraction method: Stress depth profiling of ground silicon nitride**	Acta Materialia	77 (2014) 370-378
Asif Rafiq, M.; Supancic, P.; Costa, M. E.; Vilarinho, P.M. & Deluca, M.	**Precise determination of phonon constants in lead-free monoclinic $(K_{0.5}Na_{0.5})NbO_3$ single crystals**	Applied Physics Letters	104 (2014) 011902 (5pp)
Bohacek, J.; Kharicha, A.; Ludwig, A. & Wu, M.	**Simulation of horizontal centrifugal casting: Mold filling and solidification**	International Science and Investigation Journal	54 (2014) 266-274
Buscaglia, V.; Tripathi, S.; Petkov, V.; Dapiaggi, M.; Deluca, M.; Gajovic, A. & Ren, Y.	**Average and local atomic-scale structure in $BaZr_xTi_{1-x}O_3$ (x = 0.10, 0.20, 0.40) ceramics by high-energy x-ray diffraction and Raman spectroscopy**	Journal of Physics	26 (2014) 065901 (13pp)
Daniel, R.; Jäger, E.; Todt, J.; Sartory, B.; Mitterer, C. & Keckes, J.	**Mono-textured nanocrystalline thin films with pronounced stress-gradients: On the role of grain boundaries in the stress evolution**	Journal of Applied Physics	115 (2014) 203507 (1-9)
Danzer, R.	**On the relationship between ceramic strength and the requirements for mechanical design**	Journal of the European Ceramic Society	34 (2014) 3435-3460

Author Co-Author	Title	Journal	Edition/ Year
Daves, W.; Yao, W.P. & Scheriau, S.	**Crack growth tendency of surface shear cracks in rolling sliding contact**	Key Engineering Materials	592-593 (2014) 250-253
Eck, S.; Prevedel, P.; Marsoner, S.; Ecker, W. & Illmeier, M.	**Using finite element simulation to optimise the heat treatment of tire protection chains**	Journal of Materials Engineering and Performance	23 (2014) 1288-1295
Falahati, A.; Lang, P.; Ahmadi, M. R.; Povoden-Karadeniz, E.; Kozeschnik, E. & Wu, J.	**Assessment of parameters for precipitation simulation of heat treatable aluminum alloys using differential scanning calorimetry**	Transactions of Nonferrous Metals Society of China	24 (2014) 2157-2167
Feichtinger, S.; Michelic, S. K.; Kang, Y.B. & Bernhard, C.	**In-situ observation of the dissolution of SiO_2 particles in $CaO-Al_2O_3-SiO_2$ slags and mathematical analysis of its dissolution pattern**	Journal of the American Ceramic Society	97 (2014) 316-325
Fischer, F.D.; Predan, J. & Kienzler, R.	**An easy-to-use estimate of the energy-release rate for crack arrays**	Archive of Applied Mechanics	84 (2014) 1325-1337
Fischer, F.D.; Predan, J.; Müller, R. & Kolednik, O.	**On problems with the determination of the fracture resistance for materials with spatial variations of the Young's modulus**	International Journal of Fracture	190 (2014) 23-38
Fischer, F.D. & Svoboda, J.	**Diffusion of elements and vacancies in multi-component systems**	Progress in Materials Science	60 (2014) 338-367
Fischer, F.D.; Svoboda, J. & Petryk, H.	**Thermodynamic extremal principles for irreversible processes in materials science**	Acta Materialia	67 (2014) 43831
Foronda, H.; Deluca, M.; Aksel, E.; Forrester, J.S. & Jones, J.L.	**Thermally-induced loss of piezoelectricity in ferroelectric $Na_{0.5}Bi_{0.5}TiO_3$–$BaTiO_3$**	Materials Letters	115 (2014) 132-135
Gamsjäger, E.; Chen, H. & Zwaag, S.	**Application of the cyclic phase transformation concept for determining the effective austenite/ ferrite interface mobility**	Computational Materials Science	83 (2014) 92-100
Griesser, S.; Bernhard, C. & Dippenaar, R.	**Mechanism of the peritectic phase transition in Fe-C and Fe-Ni alloys under conditions close to chemical and thermal equilibrium**	ISIJ International	54 (2014) 466-473

Author Co-Author	Title	Journal	Edition/ Year
Griesser, S. & Dippenaar, R.	**Enhanced Concentric Solidification Technique for High-Temperature Laser-Scanning Confocal Microscopy**	ISIJ International	54 (2014) 533-535
Griesser, S.; Reid, M.; Bernhard, C. & Dippenaar, R.	**Diffusional constrained crystal nucleation during peritectic phase transitions**	Acta Materialia	67 (2014) 335-341
Griesser, S.; Reid, M.; Pierer, R.; Bernhard, C. & Dippenaar, R.	**In-Situ quantification of micro-segregation that occurs during the solidification of steel**	Steel Research International	85 (2014) 1257-1265
Gruber, D. & Harmuth, H.	**A laser irradiation disc test for fracture testing of refractory fine ceramics**	Journal of the European Ceramic Society	34 (2014) 4021-4029
Harrer, W.; Deluca, M. & Morrell, R.	**Failure analysis of a ceramic ball race bearing made of Y-TZP zirconia**	Engineering Failure Analysis	36 (2014) 262-268
Jin, S.; Gruber, D. & Harmuth, H.	**Determination of Young's modulus, fracture energy and tensile strength of refractories by inverse estimation of a wedge splitting procedure**	Engineering Fracture Mechanics	116 (2014) 228-236
Jin, S.; Gruber, D.; Harmuth, H.; Soudier, J.; Meunier, P. & Lemaistre, H.	**Optimisation of monolithic lining concepts of channel induction furnace**	International Journal of Cast Metals Research	published online (2014)
Jin, S.; Harmuth, H. & Gruber, D.	**Compressive creep testing of refractories at elevated loads - Device, material law and evaluation techniques**	Journal of the European Ceramic Society	34 (2014) 4037-4042
Jin, S.; Harmuth, H. & Gruber, D.	**Creep testing of refractories at service related load levels and application for material simulation**	Advances in Science and Technology	92 (2014) 221-225
Kolednik, O.; Predan, J.; Fischer, F.D. & Fratzl, P.	**Improvements of strength and fracture resistance by spatial material property variations**	Acta Materialia	68 (2014) 279-294

Author Co-Author	Title	Journal	Edition/ Year
Kolednik, O.; Schöngrundner, R. & Fischer, F.D.	**A new view on J-integrals in elastic-plastic materials**	International Journal of Fracture	187 (2014) 77-107
Lang, P.; Povoden-Karadeniz, E.; Falahati, A. & Kozeschnik, E.	**Simulation of the effect of composition on the precipitation in 6xxx Al alloys during continuous-heating DSC**	Journal of Alloys and Compounds	612 (2014) 443-449
Lang, P.; Shan, Y.V. & Kozeschnik, E.	**The life-time of structural vacancies in the presence of solute trapping**	Materials Science Forum	794-796 (2014) 963-970
Lang, P.; Weisz, T.; Ahmadi, M. R.; Povoden-Karadeniz, E.; Falahati, A. & Kozeschnik, E.	**Thermo-kinetic simulation of the yield strength evolution of AA7075 during natural aging**	Advanced Materials Research	922 (2014) 406-411
Lang, P.; Wojcik, T.; Povoden-Karadeniz, E.; Falahati, A. & Kozeschnik, E.	**Thermo-kinetic prediction of metastable and stable phase precipitation in Al-Zn-Mg series aluminium alloys during non-isothermal DSC analysis**	Journal of Alloys and Compounds	609 (2014) 129-136
Ludwig, A.; Kharicha, A.; Hölzl, C.; Domitner, J.; Pusztai, T. & Wu M.	**3D Lattice Boltzmann flow simulations through dendritic mushy zones**	Engineering Analysis with Boundary Elements	45 (2014) 29-35
Maciol, P.; Bureau, R. & Sommitsch, C.	**An object-oriented analysis of complex numerical models**	Key Engineering Materials	611-612 (2014) 1356-1363
Magnien, J. & Khatibi, G.	**Assessment of mechanical reliability of surface mounted capacitor by an accelerated shear fatigue test technique**	Microelectronics Reliability	54 (2014) 1764-1769
Maierhofer, J.; Gänser, H.P. & Pippan, R.	**Prozessmodell zum Einbringen von Eigenspannungen durch Festwalzen**	Materialwissenschaft und Werkstofftechnik	45 (2014) 982-989
Maierhofer, J.; Pippan, R. & Gänser, H.P.	**Modified NASGRO equation for physically short cracks**	International Journal of Fatigue	59 (2014) 200-207
Maierhofer, J.; Pippan, R. & Gänser, H.P.	**Modified NASGRO equation for short cracks and application to the fitness-for-purpose assessment of surface-treated components**	Procedia Materials Science	3 (2014) 930-935

Author Co-Author	Title	Journal	Edition/ Year
Majer, Z.; Pletz, M.; Krautgasser, C.; Nahlik, L.; Hutar, P. & Bermejo, R.	**Numerical analysis of sub-critical crack growth in particulate ceramic composites**	Procedia Materials Science	3 (2014) 2071-2076
Ochensberger, W. & Kolednik, O.	**A new basis for the application of the J-integral for cyclically loaded cracks in elastic-plastic materials**	International Journal of Fracture	189 (2014) 77-101
Ochensberger, W. & Kolednik, O.	**Physically appropriate characterization of fatigue crack propagation rate in elastic-plastic materials using the J-integral concept**	International Journal of Fracture	published online (2014)
Pfeiler- Deutschmann, M.; Mayrhofer, P.H.; Chladil, K.; Penoy, M.; Michotte, C.; Kathrein, M. & Mitterer, C.	**Effect of wavelength modulation of arc evaporated Ti-Al-N/Ti-Al-V-N multilayer coatings on microstructure and mechanical/tribological properties**	Thin Solid Films	published online (2014)
Pletz, M.; Daves, W.; Yao, W.; Kubin, W. & Scheriau, S.	**Multi-scale finite element modeling to describe rolling contact fatigue in a wheel-rail test rig**	Tribology International	80 (2014) 147-155
Povoden- Karadeniz, E.; Eidenberger, E.; Lang, P.; Stechauner, G.; Leitner, H. & Kozeschnik, E.	**Simulation of precipitate evolution in Fe-25 Co-15 Mo with Si addition based on computational thermodynamics**	Journal of Alloys and Compounds	587 (2014) 158-170
Primig, S.; Ragger, K. S. & Buchmayr, B.	**EBSD study of the microstructural evolution during hot compression testing of a superduplex steel**	Materials Science Forum	783-786 (2014) 973-979
Reichmann, K.; Deluca, M.; Schütz, D. & Supancic, P.	**Load characteristics of lead-Free ceramic multilayer actuators based on bismuth-sodium-titanate**	International Journal of Applied Ceramic Technology	11 (2014) 431-435

Author Co-Author	Title	Journal	Edition/ Year
Riedl, A.; Daniel, R.; Todt, J.; Stefenelli, M.; Holec, D.; Sartory, B.; Krywka, C.; Müller, M.; Mitterer, C. & Keckes, J.	**A combinatorial X-ray sub-micron diffraction study of microstructure, residual stress and phase stability in TiAlN coatings**	Surface and Coatings Technology	257 (2014) 108-113
Schöngrundner, R.; Treml, R.; Antretter, T.; Kozic, D.; Ecker, W.; Kiener, D. & Brunner, R.	**Critical assessment of the determination of residual stress profiles in thin films by means of the ion beam layer removal method**	Thin Solid Films	564 (2014) 321-330
Shan, Y.V.; Svoboda, J.; Fischer, F.D. & Kozeschnik, E.	**Determination of substitutional-Interstitial interaction from chemical potentials of interstitials in the steel matrix**	Advanced Materials Research	922 (2014) 645-650
Sistaninia, M. & Kolednik, O.	**Effect of a single soft interlayer on the crack driving force**	Engineering Fracture Mechanics	130 (2014) 21-41
Stechauner, G. & Kozeschnik, E.	**Self-diffusion in grain boundaries and dislocation pipes in Al, Fe and Ni and application to AlN precipitation in steel**	Journal of Materials Engineering and Performance	23 (2014) 1576-1579
Stechauner, G. & Kozeschnik, E.	**Assessment of substitutional self-diffusion along short-circuit paths in Al, Fe, and Ni**	CALPHAD (Computer Coupling of Phase Diagrams and Thermochemistry)	47 (2014) 92-99
Stechauner, G. & Kozeschnik, E.	**Simulation of Cu precipitation in the Fe-Cu binary system**	Advanced Materials Research	922 (2014) 728-733
Stefenelli, M.; Riedl, A.; Todt, J.; Bartosik, M.; Daniel, R.; Mitterer, C. & Keckes, J.	**Macroscopic fracture behaviour of CrN hard coatings evaluated by X-ray diffraction coupled with four-point bending**	Materials Science Forum	768-769 (2014) 272-279

Author Co-Author	Title	Journal	Edition/ Year
Strobl, S.; Lube, T. & Schöppl, O.	**Toughness measurement on ball specimens. Part II: Experimental procedure and measurement uncertainties**	Journal of the European Ceramic Society	34 (2014) 1881-1892
Strobl, S.; Lube, T.; Supancic, P.; Stoiser, M.; Schöppl, O. & Danzer, R.	**Mechanical properties of silicon nitride rolling elements in dependence of size and shape**	Journal of the European Ceramic Society	34 (2014) 4167-4176
Strobl, S.; Rasche, S.; Krautgasser, C.; Sharova, E. & Lube, T.	**Fracture toughness testing of small ceramic discs and plates**	Journal of the European Ceramic Society	34 (2014) 1637-1642
Strobl, S.; Supancic, P.; Schöppl, O. & Danzer, R.	**A new strength test for ceramic cylinders – The Notched Roller Test**	Journal of the European Ceramic Society	34 (2014) 2575-2584
Svoboda, J. & Fischer, F.D.	**Abnormal grain growth: A non-equilibrium thermodynamic model for multi-grain binary systems**	Modelling and Simulation in Materials Science and Engineering	22 (2014) 015013 (15pp)
Svoboda, J. & Fischer, F.D.	**Generalization of the Lifshitz–Slyozov–Wagner coarsening theory to non-dilute multi-component systems**	Acta Materialia	79 (2014) 304-314
Svoboda, J.; Fischer, F.D.; Klinger, L. & Rabkin, E.	**The effect of surface contact conditions on grain boundary interdiffusion in a semi-infinite bicrystal**	Philosophical Magazine	94 (2014) 3398-3412
Svoboda, J.; Mori, G.; Prethaler, A. & Fischer, F.D.	**Determination of trapping parameters and the chemical diffusion coefficient from hydrogen permeation experiments**	Corrosion Science	82 (2014) 93-100
Svoboda, J.; Shan, Y.V.; Kozeschnik, E. & Fischer, F.D.	**Determination of depths of multiple traps for interstitials and their influence on diffusion kinetics**	Modelling and Simulation in Materials Science and Engineering	22 (2014) 65015
Svoboda, J.; Stopka, J. & Fischer, F.D.	**Two-dimensional simulation of reactive diffusion in binary systems**	Computational Materials Science	95 (2014) 309-315

Author Co-Author	Title	Journal	Edition/ Year
Teppernegg, T.; Klünsner, T.; Angerer, P.; Tritremmel, C.; Czettl, C.; Keckes, J.; Ebner, R. & Pippan, R.	**Evolution of residual stress and damage in coated hard metal milling inserts over the complete tool life**	International Journal of Refractory Metals & Hard Materials	47 (2014) 80-85
Timoshenkov, A.; Warczok, P.; Albu, M.; Klarner, J.; Kozeschnik, E.; Bureau, R. & Sommitsch, C.	**Modelling the dynamic recrystallization in C–Mn micro-alloyed steel during thermo-mechanical treatment using cellular automata**	Computational Materials Science	94 (2014) 85-94
Tkadletz, M.; Mitterer, C.; Sartory, B.; Letofsky-Papst, I.; Czettl, C. & Michotte, C.	**The effect of droplets in arc evaporated TiAlTaN hard coatings on the wear behavior**	Surface and Coatings Technology	257 (2014) 95-101
Todt, J.; Pitonak, R.; Köpf, A.; Weißenbacher, R.; Sartory, B.; Burghammer, M.; Daniel, R.; Schöberl, T. & Keckes, J.	**Superior oxidation resistance, mechanical properties and residual stresses of an Al-rich nanolamellar $Ti_{0.05}Al_{0.95}N$ coating prepared by CVD**	Surface and Coatings Technology	258 (2014) 1119-1127
Weirather, T.; Chladil, K.; Sartory, B.; Caliskanoglu, D.; Cremer, R.; Kölker, W. & Mitterer, C.	**Increased thermal stability of $Ti_{1-x}Al_xN$/TiN multilayer coatings through high temperature sputter deposition on powder-metallurgical high-speed steels**	Surface and Coatings Technology	257 (2014) 48-57
Wießner, M. & Angerer, P.	**Bayesian approach applied to the Rietveld method**	Journal of Applied Crystallography	47 (2014) 1819-1825
Yastrebov, V.A.; Fischlschweiger, M.; Cailletaud, G. & Antretter, T.	**The role of phase interface energy in martensitic transformations: A lattice Monte-Carlo simulation**	Mechanics Research Communication	56 (2014) 37-41

B) Conference papers

Author Co-Author	Title	Conference title	Conference
Bergmann, P.; Summer, F.; Grün, F.; Godor, I.; Offenbecher, M. & Laine, E.	**Tribological investigations of journal bearings by means of a close to component test methodology**	Symposium 2014 - Tribologie in Industrie und Forschung	Symposium der Österreichischen Tribologischen Gesellschaft (ÖTG) 2014
Daves, W.; Kracalik, M.; Yao, W.P. & Scheriau, S.	**Mechanisms of driving surface shear cracks in rolling sliding**	2nd International Conference on Railway Technology: Research, Development and Maintenance	2nd Int. Conference on Railway Technology: Research, Development and Maintenance
Daves, W.; Kubin, W. & Scheriau, S.	**A wheel/rail contact model with rough surfaces**	Proceedings of the 9th International Conference on Engineering Computational Technology	9th International Conference on Engineering Computational Technology
Drexler, A.; Gänser, H.P.; Ecker, W.; Oberwinkler, B. & Fischersworring-Bunk, A.	**Computationally efficient models for the forced air cooling of turbine disks**	Proceedings of the 5th International Conference on Thermal Process Modeling and Computer Simulation	5th International Conference on Thermal Process Modeling and Computer Simulation
Eck, S.; Prevedel, P.; Ecker, W. & Illmeier, M.	**Finite element simulation of stress evolution during quenching in the case of quenched and tempered tyre protection chains**	Proceedings of the European Conference on Heat Treatment and 21st IFHTSE Congress	European Conference on Heat Treatment and 21st IFHTSE Congress
Eggbauer, G.; Weber, A. & Buchmayr, B.	**Charakterisierung bainitischer Gefügzustände in Schmiedestählen**	Proceedings XXXIII. Colloquium on Metal Forming	XXXIII. Colloquium on Metal Forming
Gamsjäger, E.; Schider, S. & Wießner, M.	**Phase transformations in steels - from in-situ experiments to thermodynamically based models**	Proceedings of the 8th European Continuous Casting Conference (ECCC)	8th European Continuous Casting Conference (ECCC)

Author Co-Author	Title	Conference title	Conference
Kasberger, R. & Buchmayr, B.	**Production and characterisation of multilayer metallic composites**	Proceedings of the MEFORM14 - Production and processing of cladded materials and metal matrix composites	MEFORM 2014 Production and Processing of Cladded Materials and Metal Matrix Composites""
Kozic, D.; Treml, R.; Schöngrundner, R.; Brunner, R.; Kiener, D.; Antretter, T. & Gänser, H.P.	**Evaluation of the residual stress distribution in thin films by means of the ion beam layer removal method**	Proceedings ot the 15th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems	15th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems (EuroSimE 2014) eurosime
Kracalik, M.; Daves, W. & Scheriau, S.	**Finite element investigation of the load influence on shear crack direction and growth in wheel/rail contact**	Proceedings of the 9th International Conference on Engineering Computational Technology	9th International Conference on Engineering Computational Technology
Krajewski, P.; Bernhard, C.; Krobath, R.; Schaden, T.; Ilie, S & Louhenkilpi, S.	**IMC-B - A new experimental method to predict the crack susceptibility under continuous casting conditions**	1st ESTAD and 31st JSI Conference	1st European Steel Technology and Application Days (ESTAD) AND 31st Journées Sidérurgiques Internationales (JSI).
Krajewski, P.; Krobath, R.; Bernhard, C.; Miettinen, J.; Louhenkilpi, S.; Ilie, S. & Schaden, T.	**A novel approach for the simulation of surface cracks formation in continuous casting**	8th European Continuous Casting Conference	8th European Continuous Casting Conference
Leitner, M.; Gerstbrein, S.; Krautgartner, K. & Stoschka, M.	**Application study of post-treated high-strength steel joints in industrial crane frameworks**	Proceedings of the International Conference of the International Institute of Welding	International Conference of the International Institute of Welding

Author Co-Author	Title	Conference title	Conference
Leitner, M.; Simunek, D. & Stoschka, M.	**Local fatigue assessment of welded and high frequency mechanical impact-treated joints based on manufacturing process simulation**	Proceedings of the Ninth International Conference on Engineering Computational Technology	The 9th International Conference on Engineering Computational Technology
Macurova, K.; Angerer, P.; Schöngrundner, R.; Krivec, T.; Morianz, M.; Antretter, T.; Bermejo, R.; Pletz, M.; Brizoux, M. & Maia, W.	**Simulation of stress distribution in assembled silicon dies and deflection of printed circuit boards**	Proceedings ot the 15th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems	15th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems (EuroSimE 2014)
Pfeiler, C.; Mataln, M.; Kharicha, A.; Angeli, G. & Riener, C.K.	**Simulation of zinc film formation during continuous withdrawal of steel strips from galvaninzing baths**	Proceedings of the 23rd International Conference on Metallurgy and Materials	23rd International Conference on Metallurgy and Materials
Pfeiler- Deutschmann, M.; Rosc, J.; Hammer, H.; Kraker, E.; Parteder, G.; Hilna, W.; Maier, G.; Defregger, S. & Brunner, R.	**Experimental techniques and FEM simulation for evaluation of thermo-mechanical stress in LED devices**	LPS Proceeding 2014	4th LED Professional Symposium and Expo (LPS 2014)
Presoly, P.; Xia, G. & Bernhard, C.	**Identification of peritectic steel grades by thermal mould monitoring and DSC measurements**	8th European Continuous Casting Conference	8th European Continuous Casting Conference
Rosc, J.; Hammer, H.; Kraker, E.; Pfeiler- Deutschmann, M.; Parteder, G.; Hlina, W.; Maier, G. & Brunner, R.	**Reliability assessment of contact wires in LED-devices using in situ X-ray computed tomography and thermo-mechanical simulations**	IEEE Proceeding	Electronics System-Integration Technology Conference (ESTC) 2014
Schemmel, M.; Prevedel, P.; Schöngrundner,R.; Ecker, W. & Antretter, T.	**Modelling of phase transformations and residual stress formation in hot-work tool steel components**	Proceedings of the European Conference on Heat Treatment and 21st IFHTSE Congress	European Conference on Heat Treatment and 21st IFHTSE Congress

Author Co-Author	Title	Conference title	Conference
Stoschka, M.; Ottersböck, M. & Leitner, M.	**Integration of phase-dependent work-hardening into transient weld simulation**	Proceedings of the Ninth International Conference on Engineering Computational Technology	The 9th International Conference on Engineering Computational Technology
Summer, F.; Grün, F.; Godor, I.; Offenbecher, M. & Laine, E.	**Tribometric performance of polymer overlays by contrast with other bearing materials**	Symposium 2014 - Tribologie in Industrie und Forschung	Symposium der Österreichischen Tribologischen Gesellschaft (ÖTG) 2014
Taschauer, M.; Panzl, G.; Wieser, V.; Seemann, M. & Buchmayr, B.	**New perspectives on heat treatment of large forgings**	19th International Forgemaster Meeting	19th International Forgemaster Meeting
Teppernegg, T.; Klünsner, T.; Angerer, P.; Tritremmel, C.; Ebner, R.; Czettl, C.; Keckes, J. & Pippan, R.	**Residual stress and damage in coated hard metal milling inserts**	9th Tungsten, Refractory and Hardmaterials Conference	9th Tungsten, Refractory and Hardmaterials Conference
Triebl, C.; Spijker, C.; Raupenstrauch, H.; Jarosik, A. & Angeli, G.	**CFD-simulation of an industrial furnace in the hot-dip galvanization process**	AIChE 2014 Annual Meeting Online Proceedings	2014 AIChE Annual Meeting
Waitz, T.; Peterlechner, M.; Gammer, C.; Schmidt, V.; Tsuchiya, K.; Chakif, M.; Mangler, C. & Schindler, P.	**Nanostructured shape memory alloys: Phase transformations and martensitic interfaces studied by TEM**	Proceedings of the International Microscopy Conference IMC 2014	18th International Microscopy Congress
Yadav, S.; Rosc, J.; Sartory, B.; Brunner, R.; Sonderegger, B.; Sommitsch, C. & Poletti, C.	**Investigation of pre-existing pores in creep loaded 9Cr steel**	2nd International Congress on 3D Materials Science	2nd International Congress on 3D Materials Science

C) Posters

Author Co-Author	Title	Conference
Bermejo, R.; Supancic, P.; Kraleva, I.; Krautgasser, C.; Aldrian, F.; Morrell, R. & Danzer, R.	**Evaluation of position dependent biaxial strength of low temperature co-fired ceramic components**	TDK-EPC Poster Session
Bochkarev, A. & Popov, M.	**Ab-initio study of impurities diffusion in copper**	CECAM Workshop 1001 Long time dynamics from short time simulations""
Bochkarev, A.; Spitaler, J.; Puschnig, P. & Popov, M.	**Ab-initio study of impurities diffusion in copper**	DPG Spring Meeting 2014
Dengg, T.; Spitaler, J.; Romaner, L. & Puschnig, P.	**Temperature dependence of elastic constants of W: An ab-initio study**	DPG Spring Meeting 2014
Hofstätter, M.; Raidl, N. & Supancic, P.	**Simulation of the electrical characteristics of varistors with respect to mechanical load**	TDK-EPC Poster Session
Kozic, D.; Treml, R.; Sartory, B.; Schöngrundner, R.; Kiener, D.; Antretter, T.; Gänser, H.P. & Brunner, R.	**Residual stress investigations in thin film systems: Experiment and simulation**	1st International Conference on Functional Integrated nano Systems (nanoFIS 2014)
Kraker, E.; Hammer, H.; Rosc, J.; Brunner, R.; Defregger, S.; Hlina, W.; Pfeiler-Deutschmann, M.; Parteder, G. & Maier, G.	**Evaluation of thermo-mechanical stress in LED packages during manufacturing process**	1st International Conference on Functional Integrated nano Systems (nanoFIS 2014)
Krautgasser, C.; Bermejo, R.; Supancic, P. & Danzer, R.	**Effect of environment on the biaxial strength of a low temperature co-fired ceramic substrate**	TDK-EPC Poster Session

Author Co-Author	Title	Conference
Mühlbacher, M.; Mendez Martin, F.; Sartory, B.; Schalk, N.; Keckes, J.; Lu, J.; Hultman, L. & Mitterer, C.	**Diffusion studies in epitaxial TiN/Cu layers on MgO(001) by high resolution TEM and APT**	SCANDEM 2014: Annual Meeting of the Nordic Microscopic Society
Raidl, N.; Hofstätter, M. & Supancic, P.	**Current-voltage characteristicsof zinc oxide varistors with respect to mechanical load**	TDK-EPC Poster Session
Reyes-Huamantinco, A.; Knebl, D.; Wießner, M. & Ruban, A.	**Temperature-dependent stacking-fault energy in FeMn: The influence of Cr, Al and Si**	Magnetism, Superconductivity and Electron Correlations: Celebrating the Contributions and Scientific Legacy of Balazs L. Gyorffy
Reyes-Huamantinco, A.; Knebl, D.; Wießner, M. & Ruban, A.	**Temperature-dependent stacking-fault energy in FeMn: The influence of Cr, Al and Si**	Seminar ab initio Description of Iron and Steel ADIS 2014

D) Books

Author Co-Author	Title	Volume	Page	Edition/ Year
Waitz, T.; Schranz, W. & Tröster, A.	**"Mesoscopic phenomena in multifunctional materials (Book):** Nanoscale phase transformations in functional materials (Article)"	198	23-56	2014

BUSINESS FIGURES 2014

Business development

Profit and loss account

Balance sheet

14

Business development

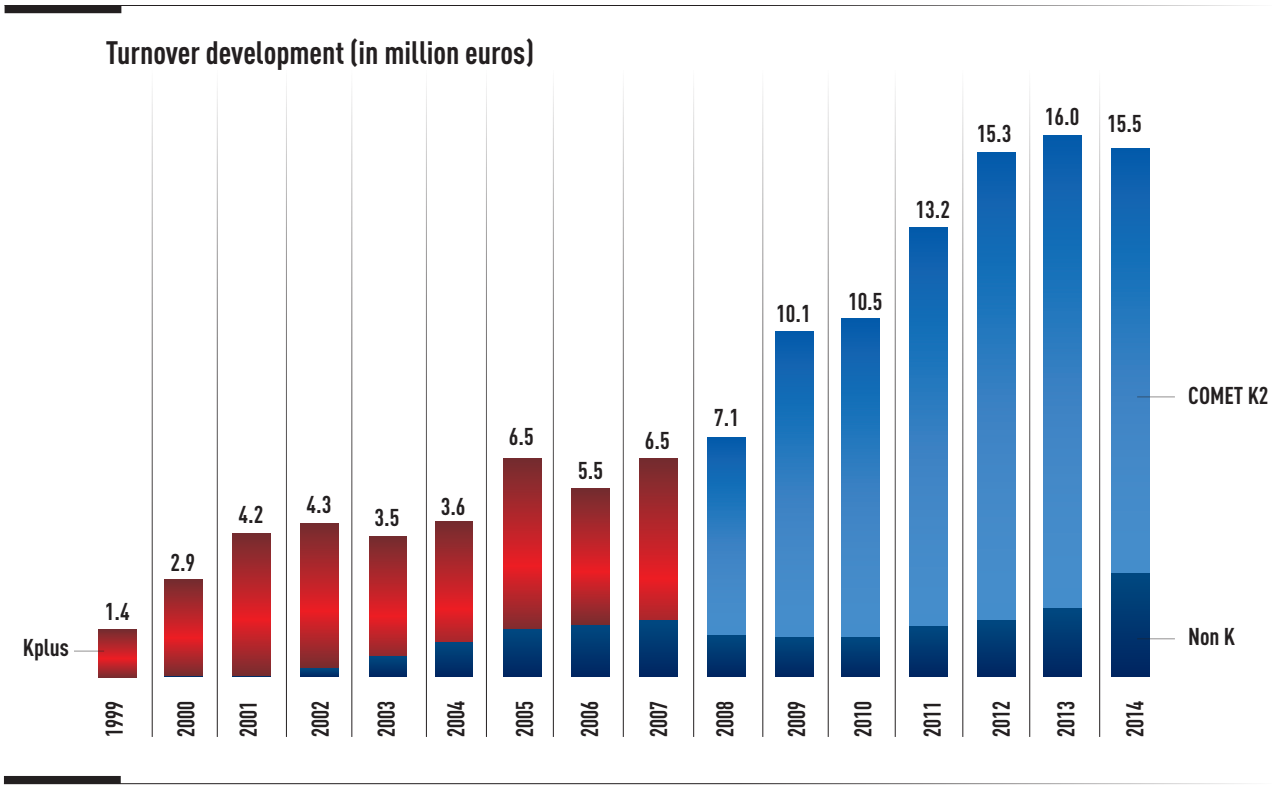
Business volume

The 2014 financial year was the second year of the second funding period (1/1/2013 to 31/12/2017) of the COMET K2 Centre for Integrated Research in Materials, Processing and Product Engineering (MPPE).

A project volume of € 59,500,000 was approved for COMET Phase II, resulting in an annual average amount of € 11,900,000. This level was significantly exceeded in the 2014 financial year with the costs in the COMET area amounting to € 12,567,808 (previous year (PY): k€ 13,935).

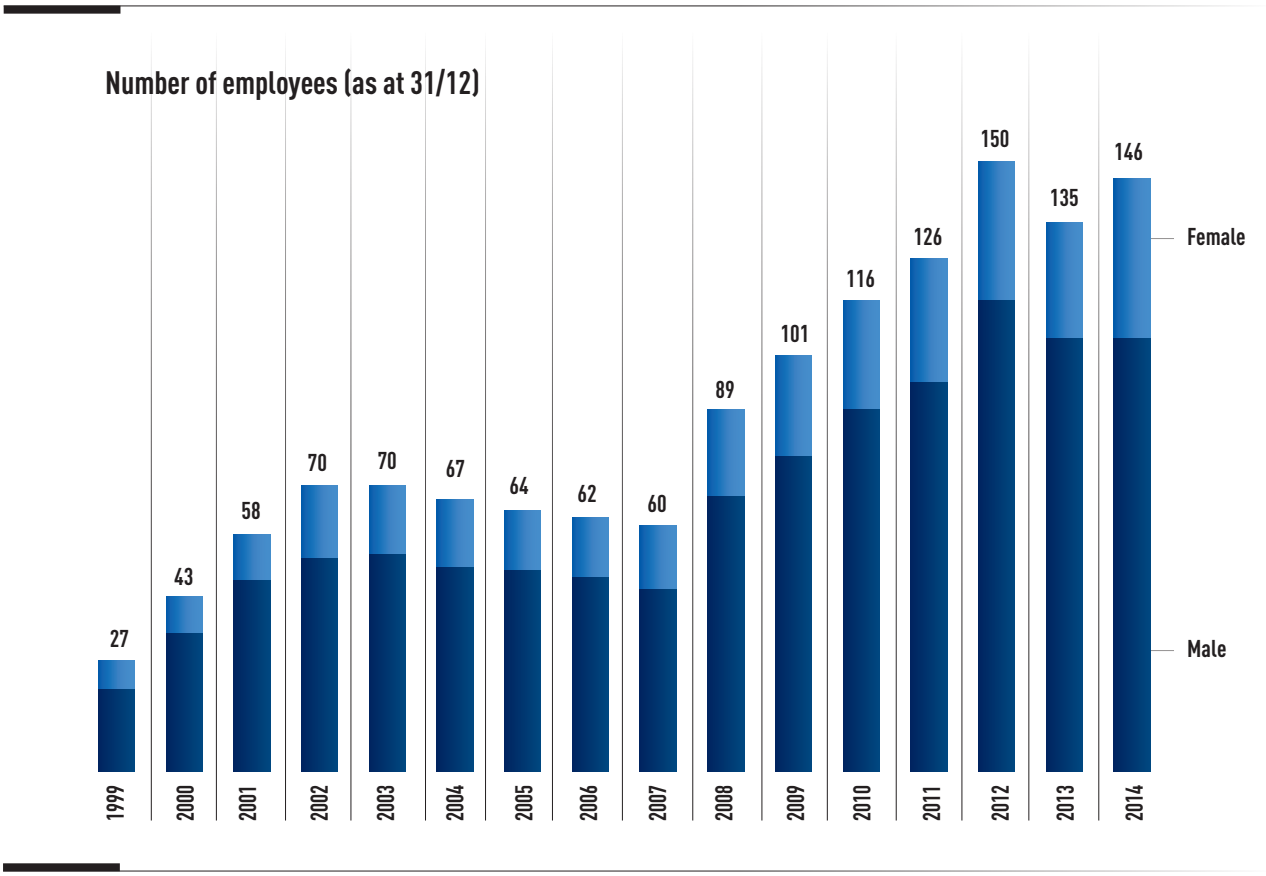
The project volume in the non-COMET area was € 715,320 (PY: k€ 400) for nationally funded projects and € 453,549 (PY: k€ 77) for internationally funded projects, which is a substantial increase compared to the previous year.

A turnover of € 1,729,359 was generated in the non-funded area (PY: k€ 1,550), representing a 19% increase over the previous year.



Staff development

The company had 146 employees / full time equivalent: 112.73 (PY: 135 / FTE 105.7) as at 31/12/2014. This increase in the 2014 financial year is due to an increase in the number of staff employees and doctoral students in non-COMET projects. The largest increase was achieved in the area of Micro-electronics.



Financial and earnings position

Earnings position

Materials Center Leoben Forschung GmbH reported an operating result of € 457,476.92 (PY: k€ 463) in the 2014 financial year.

The balance sheet profit – composed of the profit for the year of € 212,378.61 (PY loss for the year: k€ -186) plus profit carried forward of € 225,060.79 (PY: k€ 847) – thus amounts to € 437,439.40 (PY: k€ 661). An amount of € 713,376.01 (PY: k€ 649) was allocated to the profit reserve in the 2014 financial year.

Turnover mainly includes contributions of € 6,888,773.58 (PY: k€ 7,037) from the COMET partners and non-COMET project revenue of € 1,787.463,04 (PY: k€ 1,680). Work in progress amounted to € 206,410.46 (PY: k€ -31) in 2014. COMET and non-COMET funding together amounted to € 6,613,492.19 (PY: k€ 5,901). Other operating income, including the release of investment allowances and provisions amounted to € 1,090,171.70 (PY: k€ 1,047). Overall revenue including other operating income and changes in work in progress (items 1 to 5 of the profit and loss account) amounted to € 16,586,310.97 (PY: k€ 15,634) in the 2014 financial year.

Raw material expenses and expenditure for services received amounted to € 7,391,920.08 (PY: k€ 7,216), and staff expenses amounted to € 6,364,254.64 (PY: k€ 5,641).

Depreciation and amortisation in the 2014 financial year amounted to € 987,426.17 (PY: k€ 970), and other operating expenses to € 1,385,233.16 (PY: k€ 1,337).

The financial result amounted to € 33,714.39 (PY: k€ 7).

Asset position

The book value of fixed assets rose to € 2,746,594.47 (PY: k€ 2,447) in the 2014 financial year. This increase is mainly due to investments in the research areas "Materials Engineering" and "Materials for Microelectronics".

An amount of € 713,376.01 (PY: k€ 649) of the net income and profit carried forward was allocated to the profit reserves, which thus total € 4,167,760.57 (PY: k€ 3,454) as at 31/12/2014 and serve to ensure liquidity for the transition to the next COMET funding period and secure the development of research projects and activities in the future. The company thus reports a balance sheet profit of € 437,439.40 (PY: k€ 661), which will be allocated to free profit reserves.

Capital and reserves increased to € 4,897,199.97 (PY: k€ 4,407) in the 2014 financial year. The company has an equity ratio of 32.4% (PY: 24.4%) as at 31/12/2014, determined in accordance with Sec. 23 of the Austrian Company Reorganisation Act (URG).

Financial position

Net cash flow from ordinary activities was k€ 1,262 (PY: k€ 5,215), net cash flow from investment activities was € -1,288 (PY: k€ -1.102), and net cash flow from financing activities was k€ -6 (PY: k€ -17). Changes in cash and equivalents totalled k€ -32 (PY: k€ 4,069) in the 2014 financial year, bringing the value of cash and equivalents as at 31/12/2014 to k€ 7,643 (PY: k€ 7,676). This reduction in cash and equivalents is mainly due to the decrease in trust assets as at 31/12/2014.

Outlook for 2015:

In 2015, the planned project volume in the COMET area will be € 12.9m (2014: € 12.6m). In the non-COMET area, turnover is expected to remain at around € 1.7m (2014: € 1.7m) for non-funded projects, while a substantial increase to € 2.5m (2014: € 1.2m) is planned for funded research projects.

MCL plans to increase its number of employees to 160 (121 FTE) by the end of 2015 in order to be able to implement these and future projects.

Profit and Loss Account

	€	2014 €	2013 T €
1. Turnover		**1,787,463.04**	**1,680**
2. Services not yet billable		**206,410.46**	**-31**
3. Income from cash and in-kind contributions by partners COMET K2		**6,888,773.58**	**7,037**
4. Public funding and allowances			
a) income funding and allowances COMET K2	5,603,351.96		5,526
b) income funding and allowances Non Comet K2	1,010,140.23		374
		6,613,492.19	**5,901**
5. Other operating income			
a) release of investment allowances	5,930.82		17
b) income from disposal of fixed assets	0.00		0
c) income from the reversal of accruals	35,944.09		522
d) other	1,048,296.79		509
		1,090,171.70	**1,047**
6. Material expense and expenditure for services received			
a) material expense	858,997.42		1,049
b) expenditure for services received	6,532,922.66		6,167
		7,391,920.08	**7,216**
7. Staff expenses			
a) Wages	21,325.98		27
b) Salaries	4,886,462.80		4,314
c) Employee income provision fund	71,408.34		64
d) Expenses for social security payment prescribed by law as well as taxes and mandatory contributions dependent on compensation	1,337,896.06		1,191
e) Expenses for other employee benefits	47,161.46		45
		6,364,254.64	**5,641**
8. Amortization			
a) of fixed assets		**987,426.17**	**970**
9. Other operating expenses			
a) taxes, in so far as they are not on income or on revenue	16,182.48		14
b) other	1,369,050.68		1,323
		1,385,233.16	**1,337**
10. Operating result		**457,476.92**	**471**
11. Other interest income and similar income		33,714.39	7
12. Financial result		**33,714.39**	**7**
13. Profit from operating activities		**491,191.31**	**477**
14. Taxes on income and revenue		1,438.00	14
15. Net income		**489,753.31**	**463**
16. Allocation to profit reserves			
a) other reserves (free reserves)		277,374.70	649
17. Profit for the year		**212,378.61**	**-186**
18. Profit carried forward from the previous years		225,060.79	847
19. Balance sheet profit		**437,439.40**	**661**

Balance Sheet

as at 31/12	€	2014 €	2013 T €
Assets			
A. Fixed Assets			
I. Intangible Assets			
1. Licences and software		79,124.24	56
II. Tangible Assets			
1. Equipment	2,146,452.45		2,003
2. Tools, fixtures and fittings	325,093.39		368
3. Payments made on account	195,924.39		20
		2,667,470.23	2,391
		2,746,594.47	**2,447**
B. Current Assets			
I. Inventories			
1. Services not yet billable	286,420.56		80
2. Payments made on account	60,000.00		40
		346,420.56	120
II. Receivables and other Assets			
1. Receivables arising from deliveries and services	413,131.74		565
2. Receivables of cash and in-kind contributions from partner companies	1,163,758.01		1,102
3. Receivables from subsidies und project subsidies	101,625.73		143
4. Other receivables and assets	1,744,954.81		663
		3,423,470.29	2,472
III. Cash on hand and bank deposits		7,643,493.43	7,676
		11,413,384.28	**10,268**
C. Trust assets		**716,458.71**	**5,282**
D. Prepaid expenses, deferred charges		**244,546.57**	**66**
Total Assets		**15,120,984.03**	**18,063**

as at 31/12	€	2014 €	2013 T €
Liabilities and Shareholders' Equity			
A. Capital and Reserves			
I. Share capital		292,000.00	292
II. Revenue reserves			
1. Other reserves (free reserves)		4,167,760.57	3,454
III. Balance sheet profit		437,439.40	661
thereof profit carried forward from the previous years		225,060.79	847
		4,897,199.97	**4,407**
B. Investment Allowances		151.07	6
C. Accruals			
1. Tax accruals	1,013,375.18		836
		1,013,375.18	**836**
D. Liabilities			
1. Liabilities arising from deliveries and services	3,091,094.52		2,550
2. Other liabilities	517,171.52		151
thereof taxes	10,750.00		10
thereof social security	131,818.76		124
		3,608,266.04	**2,701**
E. Trust assets		**716,458.71**	**5,282**
F. Prepaid expenses, deferred charges		**4,885,533.06**	**4,831**
Total Liabilities and Shareholders' Equity		**15,120,984.03**	**18,063**
Contingent Liability		**5,744.00**	**6**

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