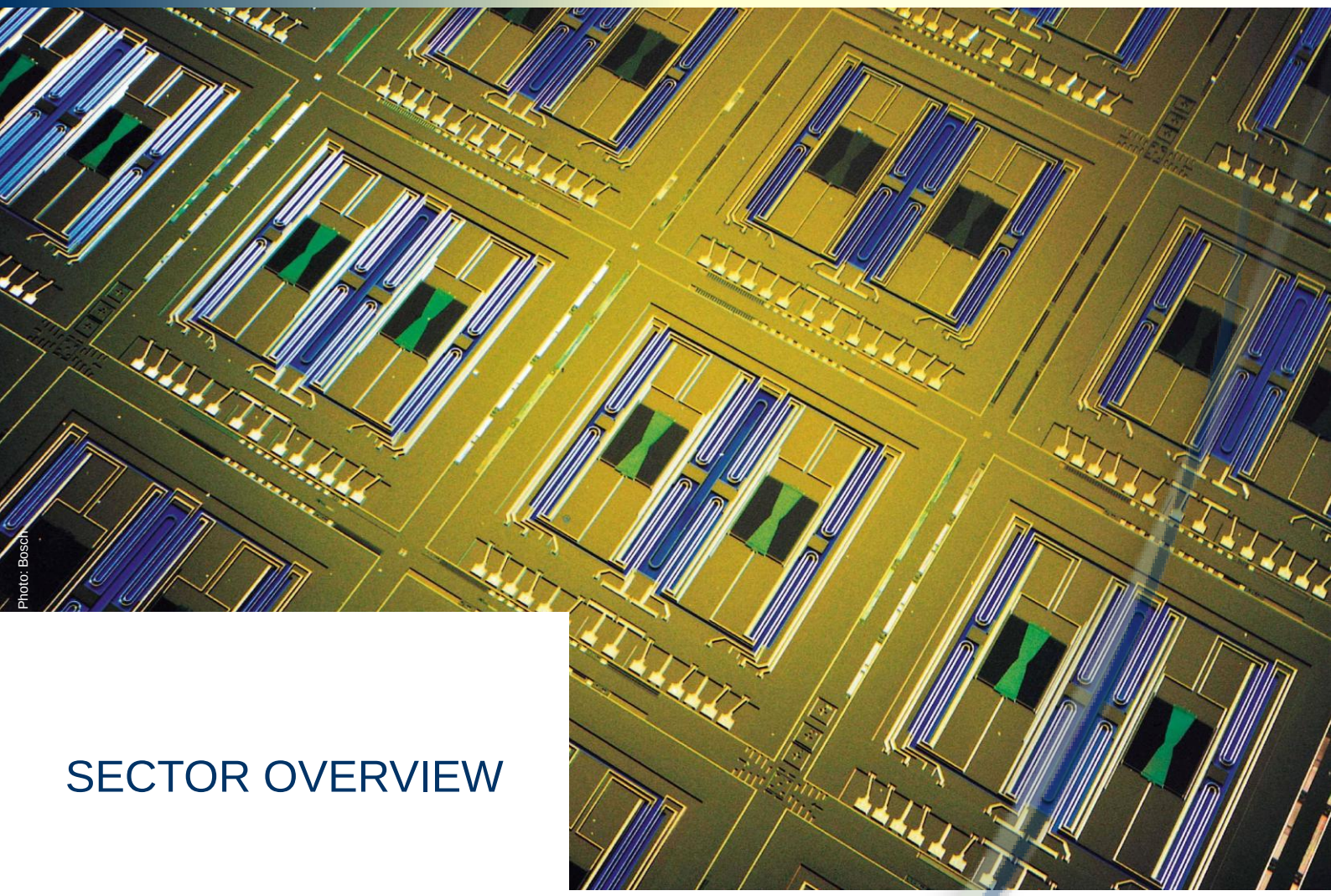


Photo: Bosch

SECTOR OVERVIEW

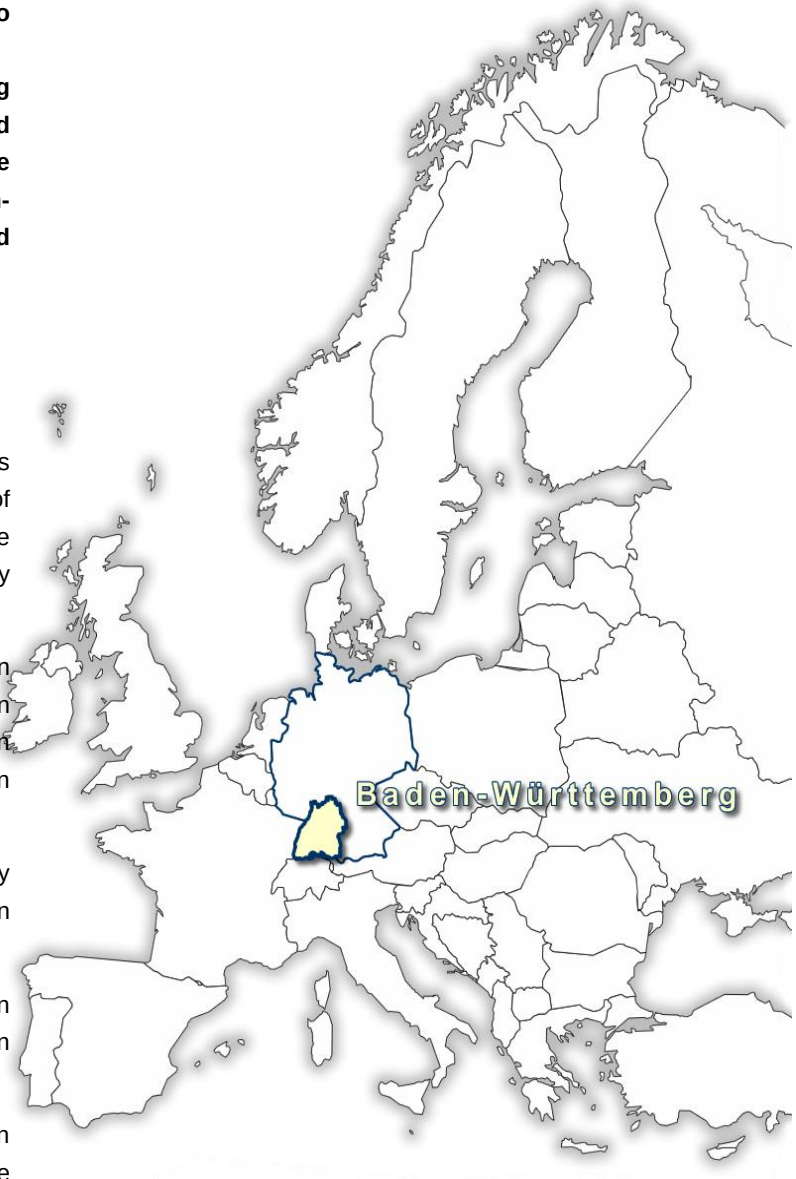
MICROSYSTEMS ENGINEERING

Baden-Württemberg

Baden-Württemberg International bw-i

Microsystems engineering “Made in Baden-Württemberg” – a global player at the heart of Europe

The location of Baden-Württemberg in the centre of Europe is an important geographical advantage which guarantees access to many important markets.
Microsystems engineering companies in Baden-Württemberg develop and produce technologically high-quality products and are therefore leading players in Germany and Europe. The products manufactured by microsystems engineers in Baden-Württemberg enjoy high national and international demand and are used throughout the world.



Microsystems engineering in Germany

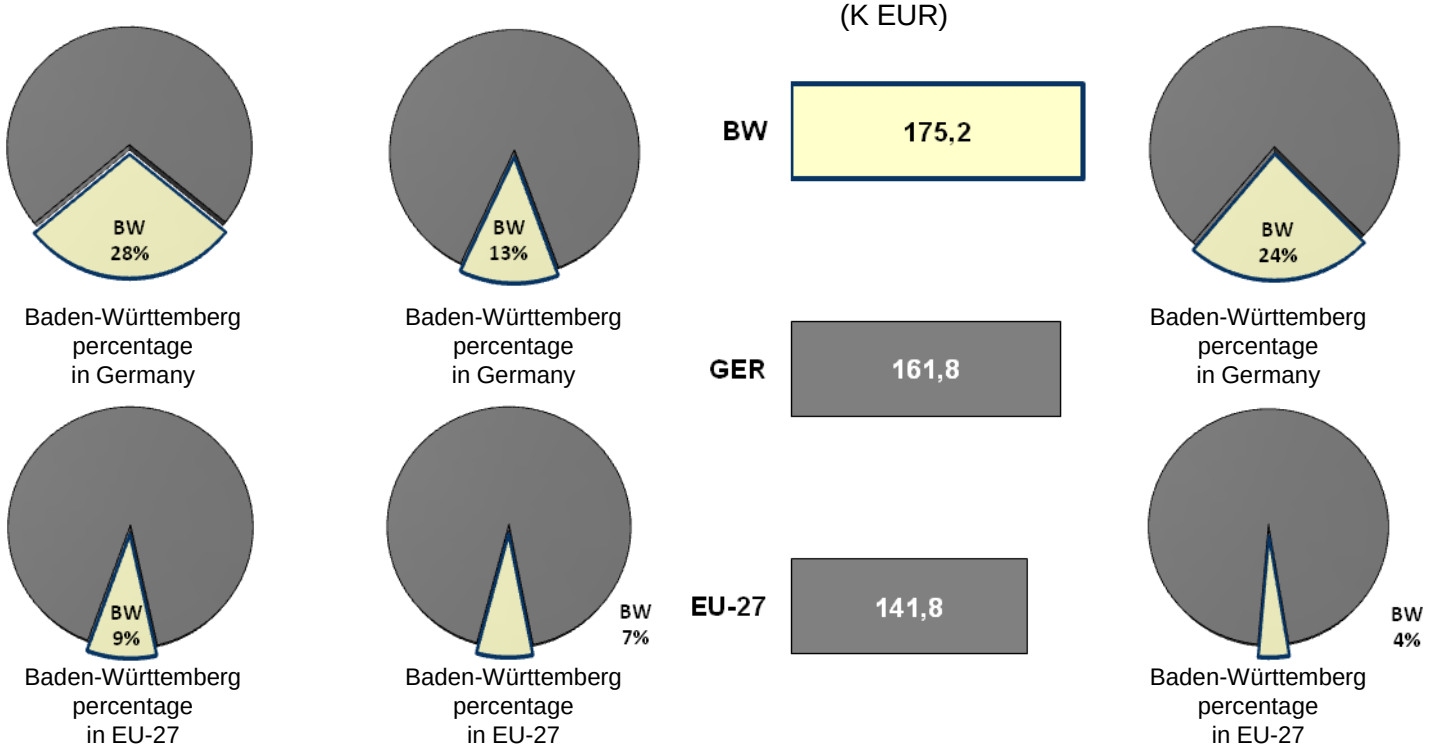
- As a typical inter-disciplinary field, modern microsystems engineering offers innovative solutions for a multitude of applications with high economic and social relevance. The spectrum of applications extends from the automotive industry through to medicine , energy and textiles.
- In Germany there are over 15,000 potential businesses active in the area of microsystems engineering. The German representatives of the sector, with a turnover of around 47 billion Euros, account for around a third of turnover in the sector in Europe and employ around 600,000 people.
- The German microsystems engineering sector is extremely innovative. No other country has such a high level of inventions in the field of microsystems engineering as Germany.
- Worldwide every second chip bears the words “Made in Germany”. Over 50% of European semiconductor production takes place in Germany.
- A multitude of German global players such as B.Braun Melsungen AG, Carl Zeiss AG, Robert Bosch GmbH and Siemens are active in the German “Microsystems engineering scene”. Many medium-sized enterprises are also extremely successful in the international market for microsystems engineering.

The microsystems engineering sector in Baden-Württemberg

Baden-Württemberg is regarded as one of the leading geographical locations for microsystems engineering in Germany.

- Baden-Württemberg is one of the most important centres for the German microsystems engineering industry.
- Around a quarter of enterprises in Germany potentially active in the field of microsystems engineering come from Baden-Württemberg and generate over one quarter of turnover in the sector.
- In Baden-Württemberg there are over 3,600 businesses concerned with microsystems engineering disciplines. The sector employs around 75,000 people in the south-west and generates a turnover of over 13 billion Euros.
- Due to the unique concentration of application sectors relevant to microsystems engineering such as the automotive industry, life sciences/medical technology, mechanical/production engineering and automation/sensors engineering, there is a unique market and customer potential for microsystems engineering companies in Baden-Württemberg.
- Baden-Württemberg is one of the most internationally innovative regions in the field of microsystems engineering. Around 14% of patents awarded worldwide in microsystems engineering come from the MicroTEC cluster in the south-west (the region of Karlsruhe, Stuttgart, Villingen-Schwenningen and Freiburg).
- In addition to above-average level of competencies in the field of microsystems engineering, an increasing number of businesses are successfully engaged in the field of nanotechnology. The number of enterprises working in nanoelectronics, nano-technology, nanoanalysis, MEMS etc. gives Baden-Württemberg a leading position in Germany with around 75 businesses.

Baden-Württemberg is a leading location for microsystems engineering in Germany



WZ-Code: 33.1; 33.2; 33.3; 33.4

* Enterprises with at least 17,500 Euros of taxable turnover and/or employees liable for social security contributions

Source: Baden-Württemberg Office of Statistics, Eurostat

The university network in Baden-Württemberg guarantees a large pool of highly-qualified employees.

High employee potential for microsystems engineering companies due to excellent higher education network.

- Microsystems engineering is an interdisciplinary technology and Baden-Württemberg's higher education establishments offer a wide range of courses related to this sector.
- At the nine universities and 23 higher education establishments in the state, approximately one sixth of all students follow courses in disciplines related to microsystems engineering. This places Baden-Württemberg above the average for Germany as a whole.
- Measured against the whole of Germany, around 17% of graduates in disciplines related to microsystems engineering graduate from higher education establishments in Baden-Württemberg.
- The Institute for Microsystems Engineering (IMTEK) at the University of Freiburg is one of the largest engineering sciences university institutes in Europe. MEMS, microsystems and nanotechnology are the main focus of research and teaching. The University of Freiburg offers Masters degrees in "Intelligent Embedded Microsystems" and Bachelors/Masters degrees in "Microsystems Engineering". The Universities of Karlsruhe and Stuttgart also have excellent courses for students interested in microsystems engineering, including courses at the Karlsruhe Institute for Microstructures Engineering and Stuttgart University Department of Microsystems Engineering.
- The specialist higher education establishments in Baden-Württemberg offer a wide range of courses in the field of microsystems engineering, such as the "Mechatronics and Microsystems Engineering" course at Heilbronn and "Mechatronics/Precision and Microsystems Engineering" at Esslingen.

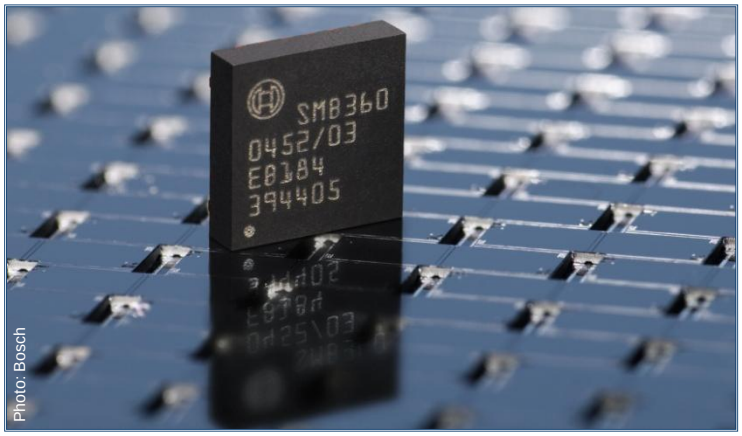
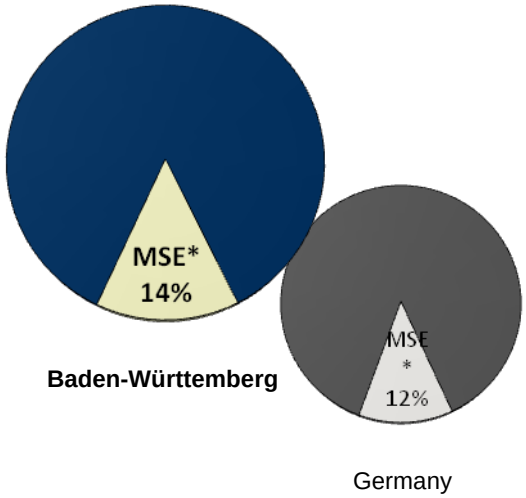


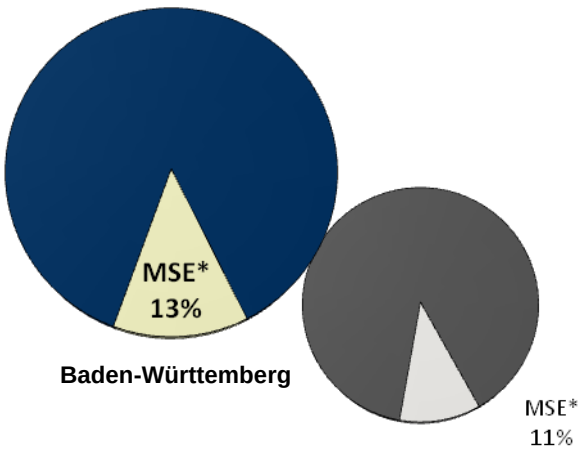
Photo: Bosch

Potential employees for microsystems engineering enterprises in Baden-Württemberg

Students in disciplines related to microsystems engineering



Graduates in disciplines related to microsystems engineering



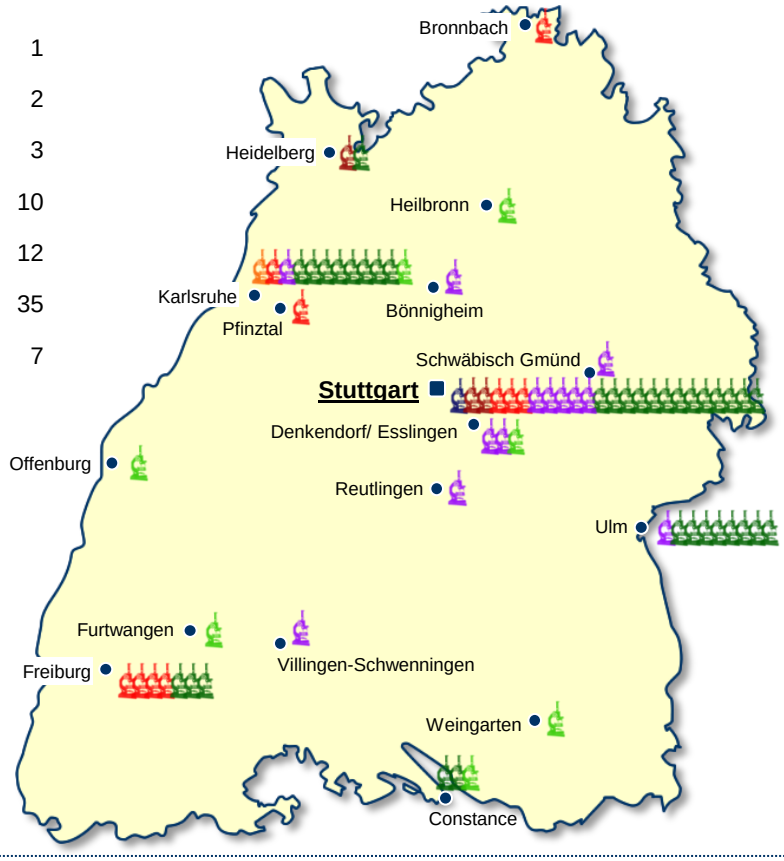
	Baden-Württemberg	Germany	Baden-Württemberg percentage in Germany
Students	35,068	245,627	**14%**
Graduates	4,839	28,888	**17%**

* Courses of study related to microsystems engineering (MST): IT, physics, general engineering, electrical engineering
Source: German Office of Statistics

Research and development activities in the microsystems engineering sector in Baden-Württemberg

Major research facilities	1
Helmholtz-Gemeinschaft e.V. Research centres	2
Max-Planck Institutes	3
Fraunhofer Institutes	10
Contract research facilities	12
University research faciltities	35
Higher educational establishment research institutes	7

Symbol stands for an institute/specialist area/centre



Baden-Württemberg – an excellent location for research and development

The microsystems engineering sector in Baden-Württemberg is supported by a high-performance, multi-faceted research network

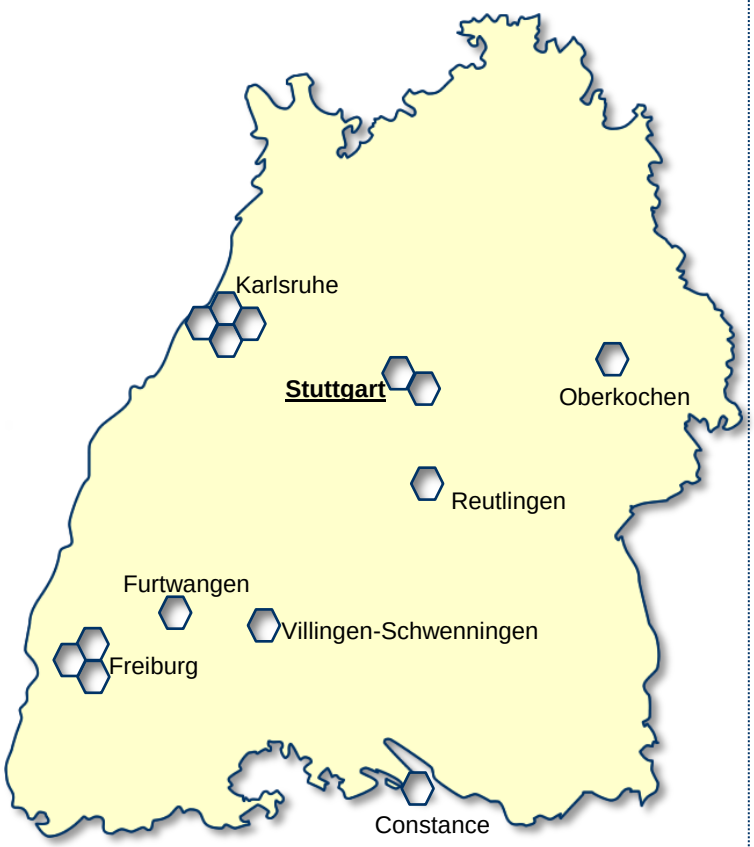
- Baden-Württemberg is a leading area in Germany for research and development in the various disciplines associated with microsystems engineering and nanotechnology.
- The Institute for Microsystems Engineering (IMTEK) at the University of Freiburg is one of the leading establishments in the world in the field of microsystems engineering with a total of 18 academic chairs and around 200 employees. The research work of the Institute covers almost all relevant areas in the inter-disciplinary field of microsystems engineering.
- The Karlsruhe region also represents another core region in the area of research and development in the field of micro and nanotechnology in Baden-Württemberg. The KIT centre for nano and micro-scale research and technology (NanoMikro) at the Karlsruhe Institute for Technology (KIT) with its large number of employees represents the largest centre in Germany in the field of nanotechnology and microsystems engineering. In 2001 the Centre of Excellence “Centre for Functional Nanostructure” (CFN) was set up in Karlsruhe by the German Research Association (DFG): with 45 group leaders, over 60 projects and over 200 associated scientists at the Technical University of Karlsruhe and the Karlsruhe Institute for Technology (KIT), it is one of the largest centres for nano-science research in Europe.
- The Stuttgart site also has a high level of research and development competency in the field of microsystems engineering. As well as numerous institutes at the University of Stuttgart, renowned institutes run by the Fraunhofer and Max-Planck company are located in Stuttgart, investigating questions associated with micro and nano technologies as part of their scientific work.
- Equally renowned contract research facilities, such as the Institute for Microstructure Technology run by the Hahn-Schickard company (HSG-IMAT) and the Stuttgart Institute for Microelectronics (IMS CHIPS), are based in Stuttgart.

Those who network are more successful - Baden-Württemberg's medical technology networks strengthen the innovative capacity and international competitiveness of enterprises.

Active co-operation projects in microsystems engineering cross company and institution boundaries and stimulate innovation, strengthen synergies and create new market potential for businesses based here.

- In the south-west of Germany a dense network of field of organisations competent in the field of microsystems engineering and sectors related to microsystems engineering has grown up. A total of 14 network organisations in Baden-Württemberg support businesses in the microsystems engineering sector.
- The cluster region in south-west Germany brings together Europe's largest collection of top researchers in microsystems engineering, with around 70 research institutes and centres, and is reinforced and broadened by a first-class environment for other disciplines such as nanotechnology and bio-sciences.
- Baden-Württemberg has a famous and highly regarded microsystems engineering network. The Micro-TEC south-west cluster comprises over 300 enterprises, higher education establishments and research facilities. Its members include global players such as Bosch, Daimler, FESTO, ZEISS, Rohwedder Microtech, ABB, SICK, Endress+Hauser, Balluff and B. Braun, as well as a multitude of innovative medium-sized companies.

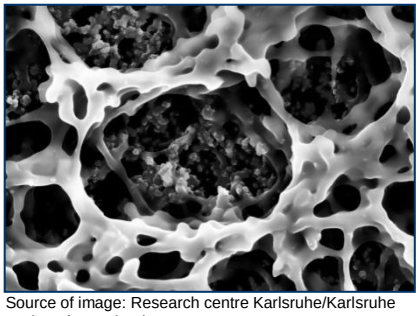
Dense network of field of competency organisations in microsystems engineering in Baden-Württemberg



Source of image: Research Centre Karlsruhe/Karlsruhe Institute for Technology

Microstructuring corrosion-resistant functional layers

Form-memory alloys made of functional layers containing Pd have the ability to change their shape reversibly as a function of temperature, which means that they can be used simultaneously as an active component and a sensor. They have a distinct resistance to chemical corrosion due to surface passivation, making wet-chemical structuring and therefore their use in microsystems engineering difficult. For the purpose of microstructuring functional layers containing Pd, researchers at the Karlsruhe Institute for Technology (KIT) have developed a procedure which includes several individual steps. These can be applied separately and adapted individually to the structure of the functional layer. Compared with competing procedures, such as laser structuring, the new procedure makes it possible for a multitude of microstructures to be processed in parallel, leading to significant cost reduction.



Source of image: Research centre Karlsruhe/Karlsruhe Institute for Technology

Microwave synthesis for the production of nanoparticles

Researchers at the Karlsruhe Institute for Technology (KIT) have developed a new procedure to synthesise conducting nanoparticles from indium tin oxide quickly and easily. Without expensive intermediate steps, crystals 10 to 15 nanometres in size can be produced which are even and regular, do not form lumps and can be easily dispersed in aqueous media. These nanocrystals can be stamped on transparent, flexible or heat-sensitive materials using conventional techniques as invisible electrodes. With the “Single pot microwave synthesis” in ionic fluids patented in the meantime, researchers have also produced other nano-scale particles such as luminescent materials which glow in colour. Chemical companies such as Evonik Degussa are already backing the new method and co-operating closely with the researchers.

Baden-Württemberg – a trade fair centre

Baden-Württemberg is one of the most dynamic trade fair locations in Germany. The federal state’s nine trade fair centres have established Baden-Württemberg as a central market platform and are characterised by their excellent innovative and multifunctional hall and area designs.

- For enterprises in the field of microsystems engineering, Baden-Württemberg has proved to be an attractive destination for exhibitions and has hosted nationally and internationally important trade fairs and conferences.
- The forward-looking range of topics covered by the various trade fair concepts open a unique opportunity up for enterprises in the field of microsystems engineering to inform themselves comprehensively on the current range of products and services offered in the area of development and manufacture, as well as to present themselves and their products at internationally renowned trade fairs.

Baden-Württemberg companies active in the microsystem technology sector:

2E mechatronic GmbH & Co. KG | ABB AG - Forschungszentrum Deutschland | ACI-ecotec GmbH & Co. KG | Aescusoft GmbH | B. Braun Melsungen AG | Binder Elektronik GmbH | BioFluidix GmbH | Bruker AXS GmbH | Carl Zeiss Industrielle Messtechnik GmbH | Dr. Fritz Faulhaber GmbH & Co. KG | ECMTEC GmbH | Endress+Hauser (Deutschland) AG & Co.KG | Festo AG & Co.KG | Haager GmbH & Co. KG | Hellma GmbH & Co.KG | Holmenkol AG | KARL STORZ GmbH & Co. KG | Kugler GmbH | MICROMETAL GmbH | MicroMountains Applications AG | Micronas GmbH | Nascatec GmbH | Northrop Grumman LITEF GmbH | Retina Implant AG | Richard Wolf GmbH | Robert Bosch GmbH | Rohwedder AG - Micro Technologies | SICK AG | TESTO AG | VEGA Grieshaber KG

Trade Fairs in the field of microsystems engineering in Baden-Württemberg

- **Control –** Specialist international trade fair for quality assurance, Neue Messe Stuttgart
- **eltefa –** Specialist trade fair for electronics and electrical engineering, Neue Messe Stuttgart
- **EMV Stuttgart –** Specialist international trade fair with workshops for electromagnetic compatibility, Neue Messe Stuttgart
- **VISION –** Specialist international trade fair for industrial image processing and identification technologies, Neue Messe Stuttgart

Further information on research establishments and networks available on request.

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