

# Motor of Innovation

Advancing education and research in Baden-Württemberg





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Baden-Württemberg



## Dear readers,

since its establishment in 2000, the Baden-Württemberg Stiftung has been one of the most important “motors of innovation” in the state. In Germany and within the European Union, Baden-Württemberg’s capacity for innovation is second to none. In no other state is the spending on research and development, the percentage of employees engaged in research-intensive industries, and the number of patents higher than in Baden-Württemberg. The foundation and its activities strive to ensure that the state can maintain this leading role well into the future.

For over 10 years, we have made targeted and substantial investments in promising key technologies, in a variety of education initiatives, and in the social responsibility of the citizens of the state. The Baden-Württemberg Stiftung aims to encourage people to actively create their own futures with ideas that will open up new fields of research, create educational opportunities for all, and prepare them to face the challenges of the future competently and creatively.



**Christoph Dahl**  
Managing Director of the Baden-Württemberg Stiftung

This is because highly skilled people produce innovations that build the foundation for social security, create the best vocational and educational training opportunities, and, in doing so, help to secure our long-term prosperity.

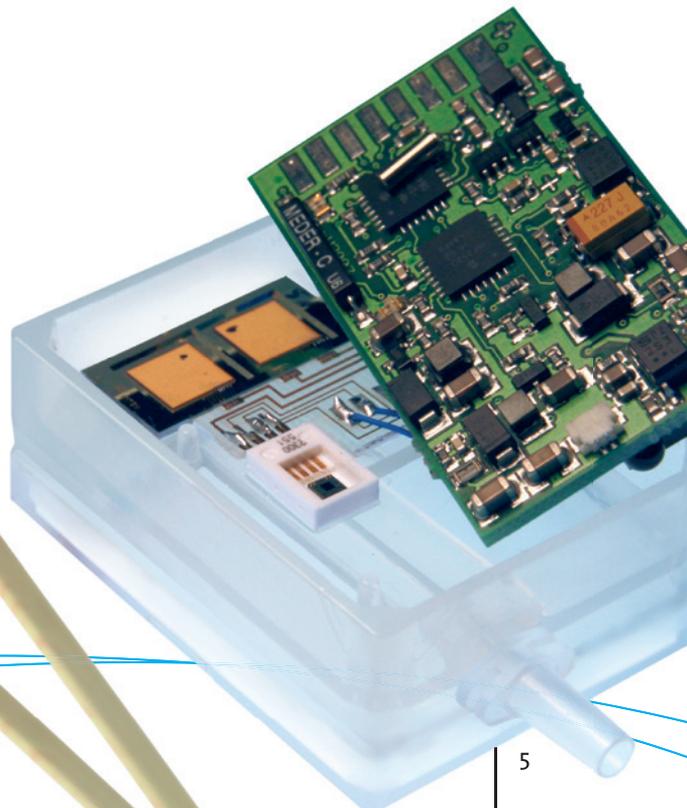
The Baden-Württemberg Stiftung uses all available sources of expertise and scientific research to identify issues and future trends in research, education, and social responsibility. The programmes and projects themselves are developed by the foundation or from ideas that are brought to us from external partners. It is with vision and expertise that the Baden-Württemberg Stiftung paves the way for people who want to use their ideas and capabilities to successfully shape our common future.

We hope you'll enjoy reading the following pages about our work.

Best wishes,



Christoph Dahl





## Creating the Future

The Baden-Württemberg Stiftung, founded in 2000, is a non-profit organization based in Stuttgart. The foundation is engaged with projects and activities that focus on science and research, education, as well as social responsibility and the arts. In all of its ventures, the Baden-Württemberg Stiftung co-operates with partners from both the public and private sectors.

The Baden-Württemberg Stiftung strives to improve the social and economic well-being of all people living in the state by undertaking projects aimed at improving the overall educational, social, and economic conditions.

## Innovation and Research

Baden-Württemberg has been one of the leading drivers of innovation in Europe for decades. The Baden-Württemberg Stiftung considers strengthening this position to be a core part of its mission. To date, the foundation has invested more than 220 million euros into several dozen research programmes in the fields of life sciences, photonics, miniaturisation, environment and energy, regional development, social and economic sciences, as well as science programmes for children and teenagers. The foundation also actively promotes the closest possible collaboration between universities, research institutes, and industry in order to help bridge the gap between the creation of new knowledge and the development of practical applications.

As mandated by its legal status in Germany, the majority of funded programmes and projects have to be initiated by the organisation itself, ensuring that the Baden-Württemberg Stiftung maintains an active and involved role in developing new programmes that serve its mission. This booklet offers a brief but informative look at some of the programmes the foundation has launched to date – many of which can rightly claim a place in the vanguard of global research.

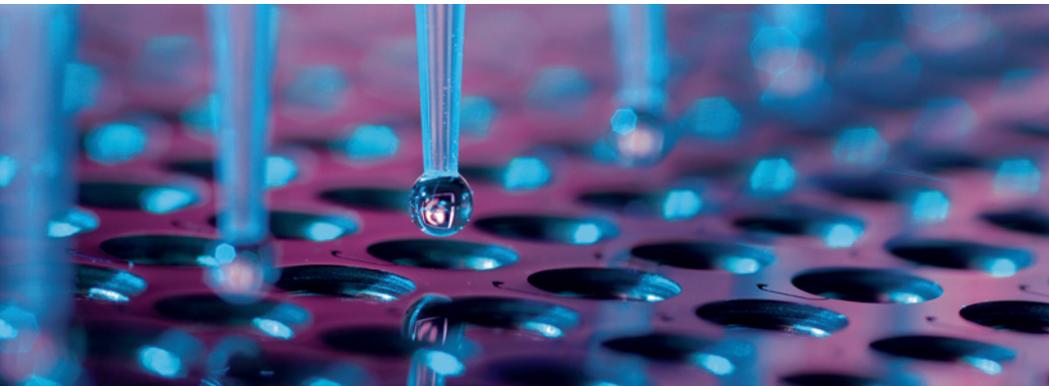
For additional information on the programmes outlined in this booklet, please visit the website [www.bwstiftung.de](http://www.bwstiftung.de) or send an email to [info@bwstiftung.de](mailto:info@bwstiftung.de).

## New Methods in the Life Sciences – New Methods for Life

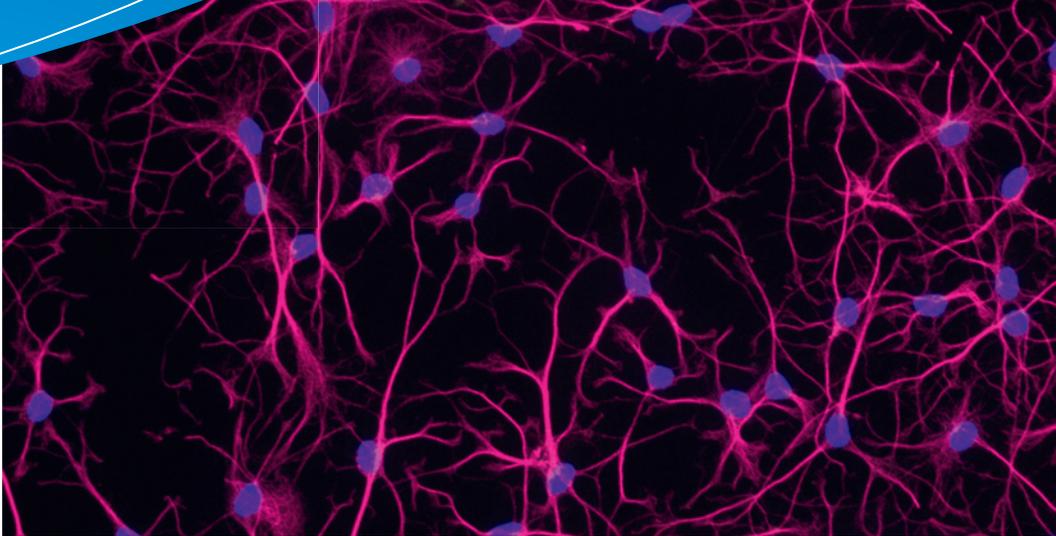
### Supporting innovative research and good health

Vast progress has been made in the life sciences due to recent technical advances. Applying and developing new methods is a common theme across the many programmes supported by the Baden-Württemberg Stiftung including research on adult stem cells, glycomics, or biocompatible materials. New methods often result in discoveries which, in turn, might contribute to the development of new therapies. As such, the Baden-Württemberg Stiftung dedicates 7.5 million euros in funding for investigations on methods in the life science research.

However, the research projects in this programme don't aim solely at developing and improving research methods, but they must also strive to answer pressing questions in the field of life sciences. Actual applications should result from the research along the lines of e.g. using new spectroscopy methods to define three-dimensional structure of membrane proteins or microscopy techniques that can label cells without staining. Meeting these important goals requires interdisciplinary teams of physicists, biologists, mathematicians, and medical researchers. Cooperating research groups and institutes from different universities work together on these projects with a true spirit of teamwork. And this is one of the ways in which the Baden-Württemberg Stiftung helps to ensure that research in Baden-Württemberg continues to improve its lofty international standing.



High-throughput methods such as automated pipetting, among others, are being developed in the “New Methods in the Life Sciences” programme



The differentiation ability of neural stem cells holds promise in the fight against degenerative neurologic diseases

## Adult Stem Cells

### Investing in long-term returns

Each year tens of thousands of people are diagnosed with cancer or hereditary diseases or fall victim to organ failure. Scientists have discovered that there is a reasonable likelihood that cell or tissue transplants will eventually provide the cure for many of these illnesses. There is still much work to be done, but if scientists can find effective and affordable methods to create adult human stem cells, they can, in turn, differentiate to become almost any other cell in the human body. This prospect motivated the Baden-Württemberg Stiftung's board of trustees to initiate the Adult Stem Cells Research Programme in 2003 which was followed by a second programme in 2010. In the first programme young scientists made remarkable progress in identifying and improving the fundamental mechanisms for the differentiation and reproduction of stem cells. In addition, the second programme focuses on tumour stem cells and the development of new therapeutic approaches.

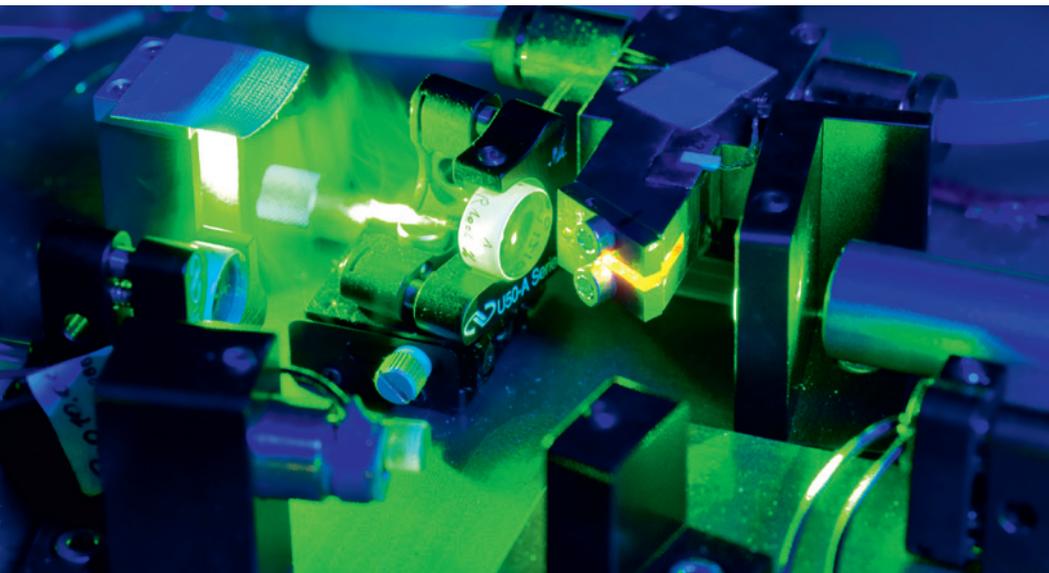
All in all, the foundation invested roughly 14 million euros in research on adult stem cells. The Baden-Württemberg Stiftung believes that the challenge of conducting cutting-edge research on stem cells – with the eventual goal of making meaningful contributions to the fight against serious disease – will be best served if Baden-Württemberg maintains its position as a top destination for up-and-coming scientists.

## Optical Technologies

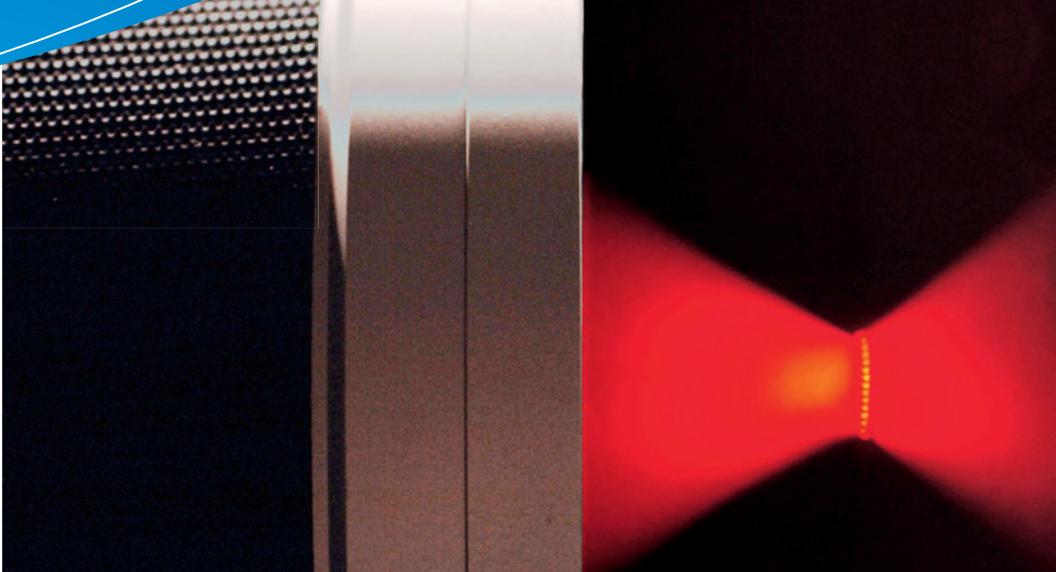
### Technologies the region relies upon

Where would modern society be without photonics? Industry's reliance on this technology has never been of greater significance, and optical technologies cover an increasing spectrum of applications, such as biotechnology, communications, illumination, medicine, metrology, or production. More and more functions are implemented by photonics, and an increasing number of products are manufactured with the aid of optical technologies.

Baden-Württemberg is the leading location for photonics in Germany. In addition to the innovative companies in the photonics industry – both domestic and international – there are many renowned research institutes in Baden-Württemberg, which cover all major photonics research areas. In recognition of the fact that photonics is a key technology for just about every corporation in Baden-Württemberg, the Baden-Württemberg Stiftung has to date invested roughly 21 million euros in outstanding research projects



A new THz emitter with radiation induced by ultrashort laser pulses



Tilted-wave interferometry for in-line nanoscale characterisation of freeform surfaces

as part of the foundation's research programme for optical technologies. Research topics are identified by industrial and scientific experts within the framework of national and international developments and with special regard to the structures of science and research found in Baden-Württemberg. So far, topics have ranged from special optical components and new light and laser sources to optical transmission, production technology, and cell diagnosis. To date, there have been six rounds of funding with 56 outstanding projects from which 20 inventions have been reported.

The most recent programme, started in 2010, includes 12 research projects on "laser processing of compound materials" and "multiscale optical metrology".

#### **Further information**

Photonics BW e. V.

Competence Network for Optical Technologies

[www.photonicsbw.de](http://www.photonicsbw.de)

## Organic Photovoltaics

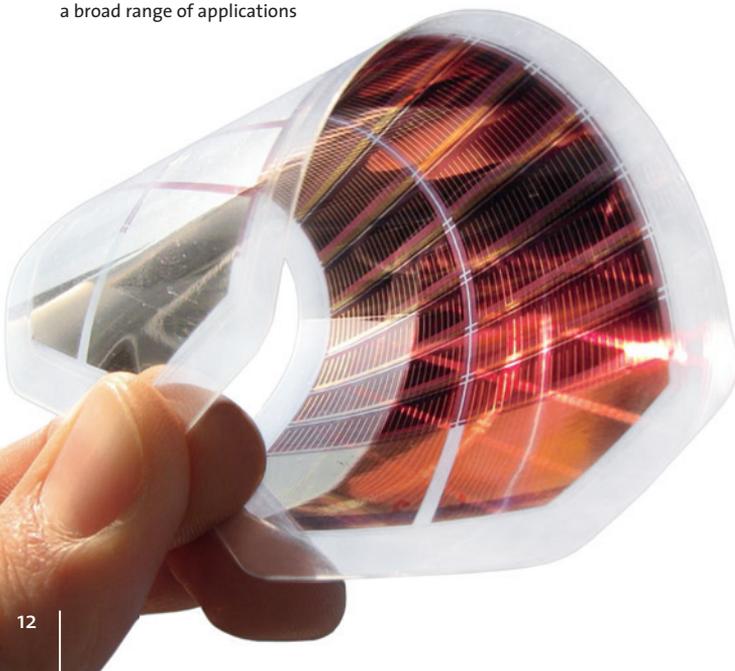
### Technology for a bright future

Germany and, in particular, Baden-Württemberg are considered to be leaders in the technology of photovoltaic energy supply. In recent years this has led to a downright “photovoltaic boom” on German roofs.

The use of organic photovoltaic cells is a young and little known technology for the production of solar energy. According to experts, the technology has enormous economic potential due to the fact that the solar panels can be produced cheaply and in large quantities using organic polymers (plastics). This is realized by using relatively conventional printing processes, that are, of course, adjusted accordingly.

Furthermore, the very simple handling of the thin, light-weight, and flexible plastic modules – that can be produced in a variety of colours – opens up completely new opportunities for design. Potential applications range from

Flexible, organic solar cells can be used in a broad range of applications





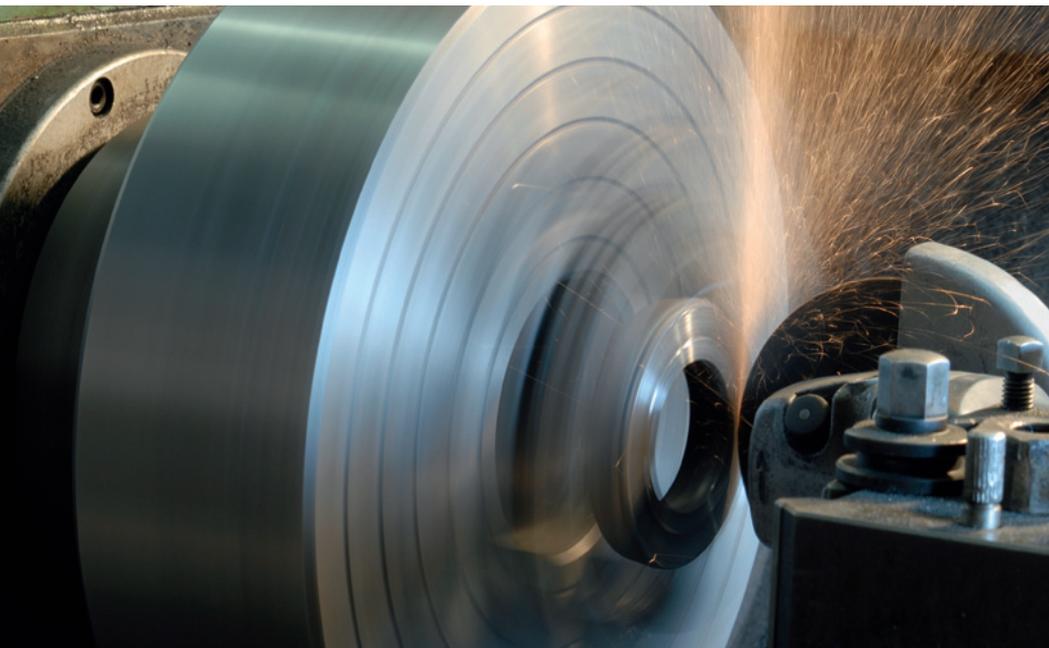
A prototype of a screenprinted dye-sensitised solar panel produced by Fraunhofer ISE

rollable charging stations for mobile electronic devices (such as mobile phones) to power-generating garments to vehicle roofs or coated cladding for buildings. The current research programme of the Baden-Württemberg Stiftung addresses this technological trend. In addition to improving the efficiency of the solar panels and securing their long-term stability, the programme also supports the development of novel processes for mass production through established printing and production processes on flexible holders and large areas. This will help ensure that there are economically viable options for use of this future technology in Baden-Württemberg.

## Production Research

### Tools for flexible, adaptive production

Industrial production has long been a high priority in Germany, where it continues to hold major economic importance. Baden-Württemberg in particular has emerged as one of the most outstanding locations for industrial production and especially plant engineering. In order to strengthen Germany's and Baden-Württemberg's position as a primary location for industrial production, it is necessary to meet the demands of a goods-producing sector that is confronted with all-encompassing changes due to shifting global markets and increasing competition. This requires enormous efforts and new strategies for the ongoing improvement of production and application of new innovations through research, development, and efficient knowledge transfer between industry and research institutes.



Baden-Württemberg: A primary location for industrial production



Storage unit in aluminium plant with automated storage and retrieval

In the field of production research tools, flexible and adaptive production systems are considered to be extremely important. The Baden-Württemberg Stiftung has launched a research programme in this area in 2007, that consists of nine thematically diverse research projects.

Although research activities in this field can be applied to production and manufacturing, they do not necessarily represent classic plant and machine tool construction. This can be, for example, clearly seen in the project “Adaptive Chemical Syntheses by 3D Printing Methods”, that focuses on the development of a special synthesis chip for a printer that is able to produce complex peptides through a specific combinatorial synthesis of individual amino acids. This project is carried out by the German Cancer Research Center (DKFZ), in cooperation with the university of Heidelberg and the Fraunhofer Institute for Manufacturing, Engineering and Automation (IPA) in Stuttgart.

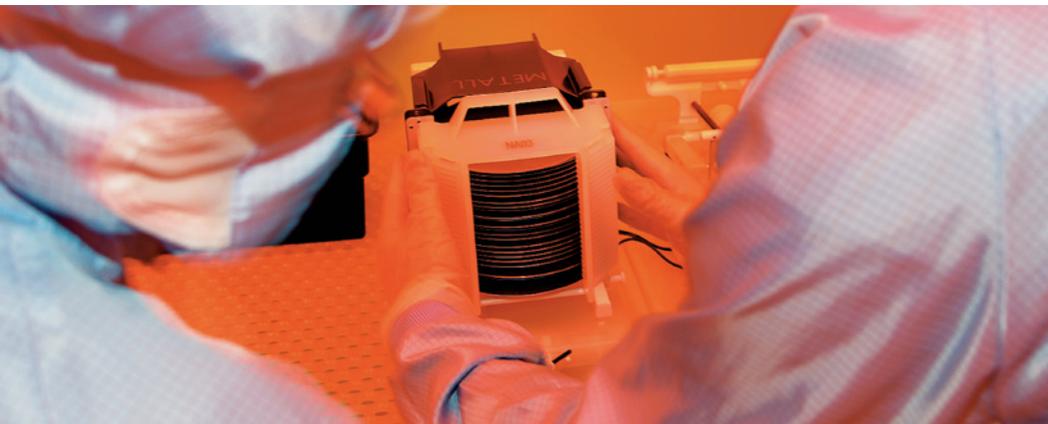
The production of peptide arrays on an area of 1 cm<sup>2</sup> allows for the synthesis of up to 40,000 different peptides at the same time, something that would help enhance innovation in both medical diagnosis and chemical analysis. Compared to the current methods, time and materials would be saved, costs would be reduced and much more complex and rapid analyses would be possible.

## Top-Class Research

### Research for the region with global ties

International studies have shown that a region's competitiveness is strongly related to its ability to establish unique and truly outstanding research projects in terms of their overall quality as well as scientific relevance. In this effort, it is of paramount importance to make the best use of resources and maximize results by focussing on a few key areas of research activity. It is equally important to encourage the international exchange of world-class researchers.

In 2004 the Baden-Württemberg Stiftung launched the Top-Class Research Programme. Laying the groundwork for outstanding, internationally-competitive research projects was the main objective behind this enterprise. Special emphasis was placed on areas of research that are of crucial importance to the region's future. Each year, the Baden-Württemberg Stiftung launches a call for applications that invites promising scientists to apply for professional and financial assistance for research work conducted in the region. The application must be submitted from within Baden-Württemberg, and at least one scientist involved in the research project must come from abroad. Assistance is granted for a total of five years. The Baden-Württemberg Stiftung has invested roughly five million euros in the programme to date.



Top international researchers are invited to Baden-Württemberg to work with research groups in the state



A scientist studies the stained samples on a protein gel

## Postdoctoral Fellowship for Leading Early Career Researchers

### Building the next generation

Creating a supportive environment for young and academically outstanding researchers to work towards earning a tenured faculty position while improving their teaching skills was the primary motivation behind the creation of the “Postdoctoral Fellowship for Leading Early Career Researchers” in 2002. Researchers who aspire to become university professors could often significantly benefit from some special support and attention, especially during the critical phase between earning their doctoral degree and receiving a full-time faculty appointment. This is the time period when up-and-coming academics invest a lot of time and effort into their own research projects in order to build their reputations and gain recognition in the field – and is one of the most likely times for someone to leave the academic career track.

The Postdoctoral Fellowship Programme specifically addresses young and academically outstanding scientists who plan to carry out their research work at a university in Baden-Württemberg. In total, 140 early career researchers have been accepted to the Fellowship Programme since its inception. Funding for infrastructure like personnel and materials is supplemented with ample networking opportunities and advanced and continuing education courses.

The success of the programme is evident in the fact that many of the participating scientists have actually gained employment as full professors. Between 50–80% of each cohort in the programme have been able to successfully take their next career step in academia or in private industry with one quarter of all participants as professors in Germany or abroad. Programme participants have also been the recipients of many prestigious awards for junior scientists such as the Intel Leadership Award, and they have been able to secure major research funding like the European Research Council’s highly sought-after “Starting Grants”. Through this initiative, the Baden-Württemberg Stiftung is able to help ensure that talented young researchers and academics are able to pursue successful careers in academia and research, contributing to Baden-Württemberg’s research standing and capacity.

## The Baden-Württemberg-STIPENDIUM

### Promoting international exchange

In today’s world, international experience and intercultural skills are increasingly considered key criteria for professional success. Young people, however, are often given little guidance or support when they attempt to pursue an international experience that will ultimately broaden their horizons and develop their professional skills. One of the first programmes launched by the Baden-Württemberg Stiftung was the Baden-Württemberg-STIPENDIUM (BWS). Started in 2001, the scholarship programme was created to give secondary school students, university students, and graduates of vocational training programmes (e.g. photographers, fashion designers, mechanics, dental technicians) the opportunity to spend time abroad. Young people from Baden-Württemberg are sent abroad to study, and, in return, international students come to Baden-Württemberg to complete internships or attend local secondary schools or universities.

University students applying for a BWS scholarship go abroad for anywhere between six and 11 months. Applicants in Baden-Württemberg may study at any



Sculptress Saskia Mieskes is among the thousands of young people who received a Baden-Württemberg-STIPENDIUM

higher education institution that has a formal partnership with their own university. In return, students from international universities can apply for a BWS scholarship to come and study at a university in Baden-Württemberg. People who are already employed can apply for a BWS scholarship to complete an internship. Applicants for the internships come from Baden-Württemberg or abroad and most possess above-average qualifications in a variety of vocational fields. The secondary school programme focuses primarily on the exchange of students to strengthen the historic ties between Baden-Württemberg and countries in Central and Eastern Europe. Students generally spend one year in the host country of their choice, living with a local family. This home stay experience enables students to live in a safe environment while gaining important first-hand experience with the local culture and habits.

There are ample opportunities during the scholarship period and beyond for BWS scholarship recipients and alumni to get in touch with each other, creating a network that offers many personal and professional benefits. All over the world, regional chapters enable current and former scholarship holders to meet on a regular basis. The Association of Scholarship Holders and Friends of the Baden-Württemberg-STIPENDIUM actively promotes the exchange of experiences and encourages networking between scholarship recipients, the Baden-Württemberg Stiftung, and the affiliated educational institutions and employers.

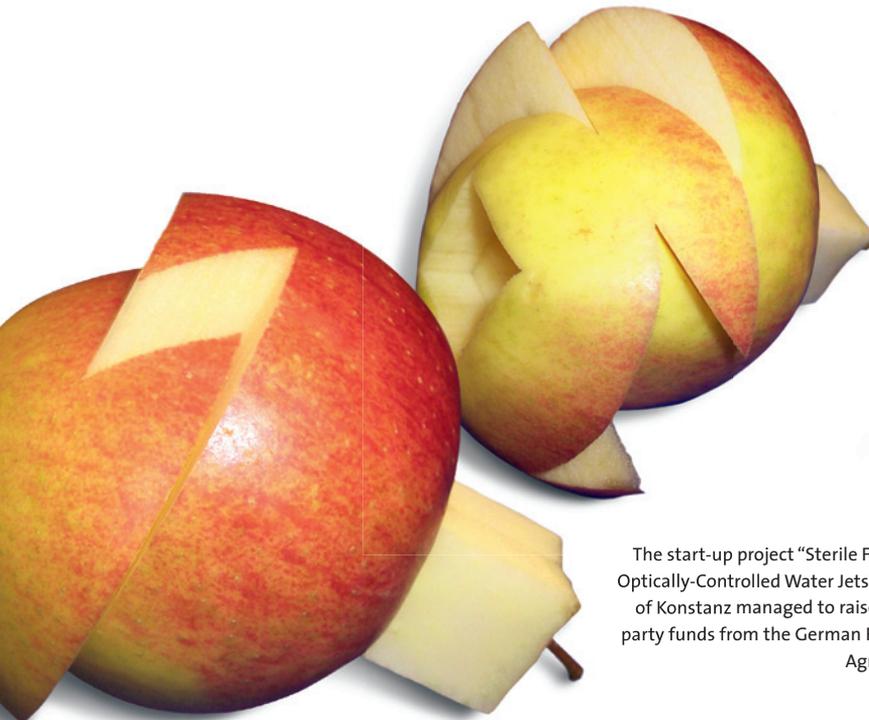
#### Further information

[www.bw-stipendium.de](http://www.bw-stipendium.de)

## Programme for Research at Universities of Applied Sciences and Cooperative Education

### Excellent research projects

The universities of applied sciences in Baden-Württemberg make significant contributions to the higher education and research landscape of the state through their excellent research projects. The Baden-Württemberg Stiftung aimed to spur new research projects at universities of applied sciences and universities of cooperative education in Baden-Württemberg with the start of the “Programme for Research at Universities of Applied Sciences and Cooperative Education” in 2005. Five innovative new degree programmes were created in addition to 10 research projects and 21 other initiatives. The *Impulsprojekte* (‘start-up projects’) are intended to support feasibility studies or test projects that may then qualify for funding from other organizations such as the German Federal Ministry for Education and Research, the German Research Foundation (DFG), the EU, and others.



The start-up project “Sterile Food Processing by Optically-Controlled Water Jets” at the University of Konstanz managed to raise additional third-party funds from the German Federal Agency for Agriculture and Food



The programme provides important insights into how educational processes work

## Educational Research

### Crucial input for educational decisions

Educational Research includes basic research that investigates structures, processes and outcomes related to education. One of the goals is to help inform teaching in both primary and secondary education. In addition, this research should help provide important input for policy-makers who make decisions about education. The Baden-Württemberg Stiftung established the first Educational Research programme in 2005 with an initial commitment of 1.5 million euros. The programme was extremely in demand and the initial funding round was very competitive: of the 74 project proposals, finally eight were selected and carried out. In 2011 the foundation launched a second programme called “Network of Empirical Educational Research” to strengthen the research capacities in Baden-Württemberg in this important area, building a research cluster. Research groups from a variety of sub-disciplines in Education Research such as pedagogy, psychology, sociology, or economics will work closely together to explore questions in educational research.

## Nanotechnology

### Invisible new world

Nanotechnology is one of the most important technologies of the 21st century, enabling scientists to understand more and more about the world of atoms and molecules. Scientific progress in the field of nanotechnology has been the key to a countless new products, processes, and technologies. The range of applications made possible by advancements in nanotechnologies ranges from scratch-proof car paint to increasingly powerful microchips and high-performance insulators. The Baden-Württemberg Stiftung acknowledges the importance of nanotechnology as a key and cross-sectorial technology. In 2001, the Functional Nanostructures Research Programme was launched in collaboration with the regional Competence Network for Functional Nanostructures, a network that produces outstanding research results while promoting strong interdisciplinary exchange and unparalleled support for young scientists. The Functional Nanostructures programme aims at analysing the production, features, and operating modes of functional nanostructures with the ultimate goal of laying the foundation for new applications and enhancing existing applications. A new three-year funding period will be launched in 2012 with a specific research focus on bionanotechnology.

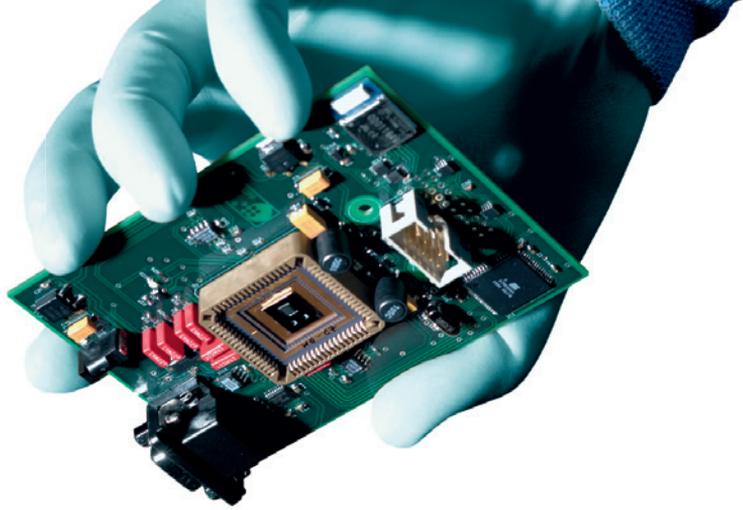
### Further information

Competence Network for Functional Nanostructures  
[www.nanonetz-bw.de](http://www.nanonetz-bw.de)



Minuscule carbon pipes act as electronic transistors, making future generation computers even more effective

Compartment air can be monitored and controlled by means of a small sensor



## Microsystems Technology

### Tiny Electronic Helpers

Microsystems Technology (MST) is an enabling technology for a wide range of applications in the automotive, electronics, and, in particular, the biomedical engineering sectors.

MST research and development in Baden-Württemberg enjoys an impressive reputation, benefiting from a large number of innovative companies as well as world class higher education and research institutions. Microscopic components, such as microsensors and microactuators, are being developed that possess the ability to sense, make decisions, and take action.

In January 2009 the Baden-Württemberg Stiftung launched the Microsystems Technology for Life Sciences programme. Nine projects with a total budget of more than four million euros were selected to take part in the three-year programme. The goal is to find ways to monitor health and environmental factors – in a way that is both mobile and convenient – with the help of MST sensor and actuator systems.

As such, researchers are tasked with identifying and developing new approaches to the field of rapid on-site analytics. One project, for example, involves the development of a microfluidic platform for rapid on-site analytics based on classical polymerase chain reaction (PCR) procedures that includes all the steps from lysis to read-out in a single disc. The researchers were also asked to come up with solutions for monitoring and action systems for use on humans. These systems can help equip medical implants or bandages with additional functionalities and even a kind of intelligence: these devices can, for instance, monitor critical parameters in high risk cardiovascular patients and take necessary actions.

## Motor of Innovation

### Publisher

Baden-Württemberg Stiftung gGmbH  
Im Kaisemer 1, D-70191 Stuttgart

### Liability

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### Editor

Megan Brenn-White, The Brenn-White Group, New York City (USA)

### Design and Layout

FLAD & FLAD Communication GmbH, Heroldsberg

### Printing

LOUKO-Druck GmbH, Nürnberg

### Photos

KD Busch Studio für professionelle Fotografie, Stuttgart; Büro 31 Bernd Müller Fotografie, Augsburg;  
Prof. Dr. Rolf Brenner, Dr. Hans-Jörg Habisch, Prof. Dr. Alexander Storch (page 9); Eugenio Garbusi,  
Institut für Technische Optik, Universität Stuttgart (page 11); FhG-ISE (page 12); Fraunhofer ISE (page 13);  
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### Images

**Cover picture:** Microsystems technology allows scientists to use the tiniest volumes of liquids for biochemical analyses and other applications. **Inside:** With the aid of a very small platform containing oscillating crystal sensors, blood typing could in future become a problem-free procedure. **This page:** Small micelles of polymer molecules are used to produce nano-sized gold particles.

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- The Baden-Württemberg Stiftung advocates a vital Baden-Württemberg with a high quality of life for all its residents. It helps pave the way for advanced technological progress, high quality education, and a responsible relationship with fellow human beings. The Baden-Württemberg Stiftung is one of the major foundations in Germany. It is the only foundation which exclusively and above party lines invests in the future of the state of Baden-Württemberg – and thus in the future of its citizens.



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