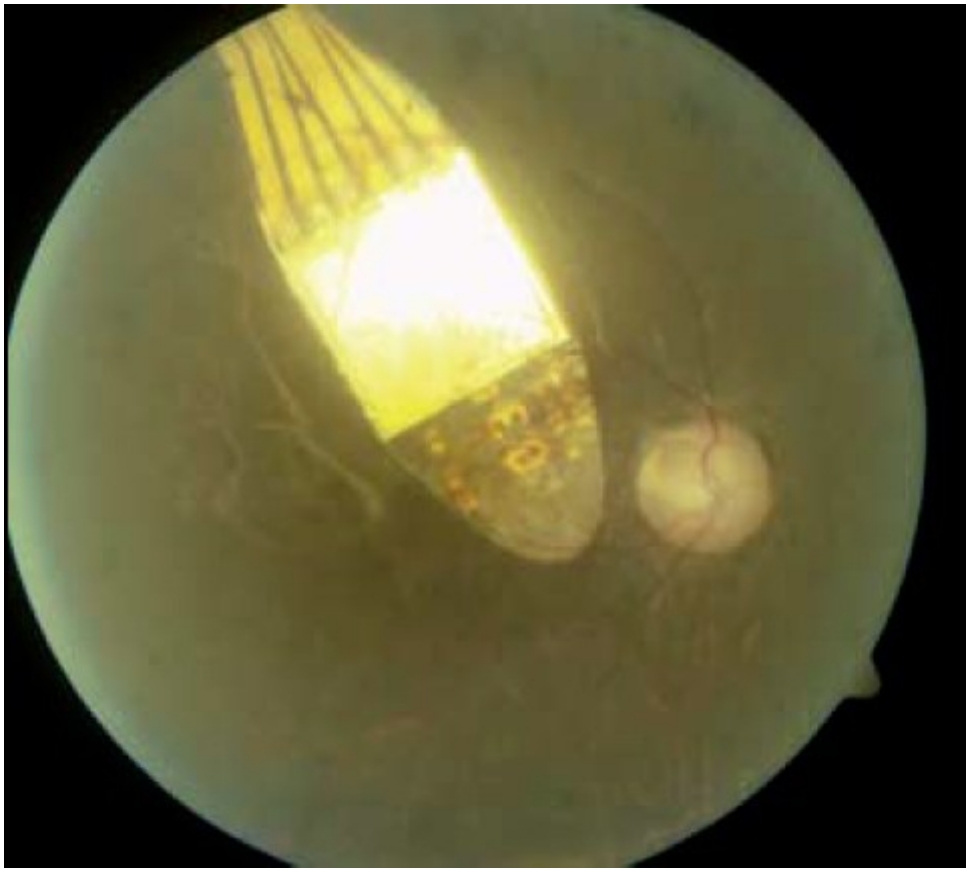
PRONTO develops microsystems for and with companies

Since 2010, PRONTO, a project run by the MicroTEC Südwest cluster, has been focusing on the production of innovative microsystems for application in the medical and other sectors. PRONTO provides microsystems development support up to small-scale production. Customers who are seeking to implement their ideas into concrete microsystems solutions can count on the expertise and infrastructure of four institutes.



The subretinal microchip, just 3x3 mm, is placed under the retina in a spot called the macula. The chip's tiny light sensors are triggered by natural light, electrical impulses stimulate the retinal neurons in response to brightness and the optic nerve sends signals to the brain where they are translated into images.

Microsystems technology is widely used in many areas, including the medical, information and communication sectors. Microsystems are miniaturised systems only a few micrometers in size that interact with their environment. Such microsystems usually consist of a circuit board with embedded

electronics and a chip that evaluates the signal of an integrated sensor and controls an actuator that performs motion or some other reaction. Notebooks, for example, are equipped with position sensors that can detect if they have been dropped; chips analyse the signal and the notebook is automatically and immediately switched off to prevent damage.

A more complex example of a microsystems-based device is a subretinal implant that helps restore partial vision to people whose blindness is due to the degeneration of the photosensitive cells in the retina. "The device is currently in the clinical trial stage and several patients have received implants. It was developed with the support of two current PRONTO members," says Dr. Christine Harendt, head of department and PRONTO spokesperson at the Institute for Microelectronics in Stuttgart (IMS CHIPS).

"Cooperative projects like these demonstrated the need to simplify coordination processes between the institutes involved. In consequence, three institutions with core competences in microsystems technology joined forces and established PRONTO: IMS CHIPS and two institutes of the Hahn-Schickard Society for Applied Research – HSG-IMIT and HSG-IMAT," says Harendt. PRONTO is funded by the German Federal Ministry of Education and Research (BMBF) and the Baden-Württemberg government and its goal is to support clients in the development of complex microsystems by providing them with expert knowledge and the required equipment.

PRONTO offers SMEs access to comprehensive experience in the production of microsystems

Dr. Christine Harendt from IMS CHIPS in Stuttgart has been involved with microsystems technology since 1988. As the head of an IMS CHIPS department focused on add-on processes, she is in charge of the institute's PRONTO-related activities and brings the institute's expertise to the project.

The Institute for Microelectronics in Stuttgart (IMS CHIPS) has many core competences, including chip electronics and image sensors such as those used for the subretinal implant developed by

Retina AG. The Hahn-Schickard Society Institute for Micro Assembly Technology (HSG-IMAT) specialises in the construction and assembly of microsystems using a broad range of different materials. The Institute for Micro- and Information Technology (HSG-IMIT) in Villingen-Schwenningen is specialised in microsystems involving electricity-driven mechanical processes and also in microfluidic systems. The institute has long-standing experience with applications such as lab-on-a-chip diagnostics. Lab-on-a-chip integrates several laboratory functions on one chip which uses capillary liquid transport to handle and automatically analyse extremely small fluid volumes.

The NMI Natural and Medical Sciences Institute at the University of Tübingen joined PRONTO in May 2014 and expands the platform's range of expertise with its special knowledge in the development and production of microelectrode arrays (microfluidic systems). The NMI also brings on board valuable expertise in the field of biostable and biocompatible materials. "In addition to its special expertise in the medical area and its analytical skills, the NMI is also highly experienced in the establishment of start-up companies. This expertise is particularly important in the effective transfer of our findings into SME products," says Harendt.

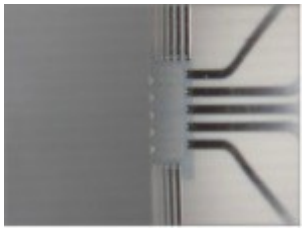
"Microsystems technology is extremely versatile and can be used in many areas"

"Microsystems never cease to amaze me. They can be used for more applications than you initially realise. One often only considers what they can be used for when someone asks whether this or that is possible," said the chemist. "Most of our clients are SMEs who are looking to implement their ideas for microsystems into concrete solutions and who need support to do so," says Harendt, referring to PRONTO's major target group.

"When a client contacts us, we first assess the enquiry and identify the most competent partner. If the company is considering developing a microsystems-based device for application in the field of medicine, we put them in touch with the NMI, which is the institute with the most experience in this particular area," says Harendt. "We then meet with the company to discuss issues related to the state-of-the-art of the technology and its potential application opportunities. Once these issues have been clarified, we go on to find out which components the company needs and whether the PRONTO institutes already have access to the required processes and structures, thus saving some time-consuming development processes. We might be closer to a product than we initially think. We then create a cost estimate and define milestones in cooperation with the client. Depending on the necessary pre-developments, the project might turn out to be eligible for funding or the client might decide to commission PRONTO to develop a prototype or set up small-scale production," says Harendt explaining the process. "However, we are not the right partner for companies whose project is still in the basic research stage and that are not yet thinking about its potential application," says Harendt highlighting the development stages that are of interest to PRONTO.

"Our institutes complement each other perfectly all along the value chain, even up to the prototype and small-scale production stages; each of the four institutes is specifically focused on a specific manufacturing step. The platform thus establishes manufacturing chains with well-designed process protocols and coordinates them with other projects. The coordination of the processes improves with every project we are working on. This enables the cooperation partners to hand over project stages quickly and avoids excessive red tape. Intensive cooperation between the institutes through ongoing projects has always been the goal of the PRONTO partners," says Harendt. "We work very closely together, so everybody knows very well which skills a person has and which technologies and analytical methods are available at which institute. This, along with the fact that the institutes are located in close geographic vicinity, greatly facilitates project coordination."

Innovative project ideas are turned into products by distributing the manufacturing processes among the partners involved



The PRONTO project Ultimum is focused on the development of microchips. Flexible conductor plate and electronics enable the microchips to adapt to movement.

PRONTO is currently supervising seven projects for application in a broad range of areas. PRONTO gives SMEs access to existing production processes, equipment, personnel and the expertise of the institutes involved, thus enabling them to create the infrastructure that they need to overcome the cost-intensive innovation barrier that the product development stage usually represents.

The PRONTO project Ultimum has been relatively successful and its run-time will be prolonged. Ultimum is focused on the development of a technology for embedding ultra-thin chips with bendable electronics inside flexible polymer circuit boards. The project is being carried out in cooperation with circuit board specialists Würth Elektronik GmbH & Co. KG and Robert Bosch GmbH. Combined with biosensors, the chips can be used for a wide range of applications, for example as patches in the field of medicine. The bendable elements, which were developed by PRONTO, will now be used by the MicroTEC Südwest cluster for producing a flexible 'smart implant'. The NMI will specifically deal with the biocompatibility of the smart electronic implants. Once the project is successfully completed, the implant will have the potential to be used as a casing-free brain implant and as a foundation for other smart microimplants for use in diagnostics and therapy.

The PRONTO institutes are convinced that the concept is a good one and hope to ensure the sustainability of PRONTO with further contracts and projects. "The institutes will continue with PRONTO when funding comes to an end. Our wide-ranging portfolio and experience enables us to deal with a very large field of microsystems technology issues and we are excited to see what new challenges the future will bring," concludes Harendt.

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BIOPRO

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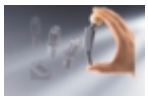
Biochips: microsystems technology for the life sciences



Implants of the future: bioactive, corrosion-resistant and antibacterial