Microtechnology for the 90s

Hahn-Schickard-Institut

With microtechnology promising to be one of the hot topics in newly emerging technologies in the 1990's, TNI's Gisbert Schmitz recently made good use of an opportunity for a hands-on discussion with Dr. Rainer Günzler of Germany's Hahn - Schickard - Institute for Micro- and Information Technology (HSI). Headquartered in Villingen, Germany, HSI was founded in 1988 at the initiative of the State of Baden-Wü rttemberg, the regional Chamber of Commerce and numerous enterprises from both the public and private sectors. HSI is one of several institutes supported by the Hahn - Schickard - Society for Applied Research (HSG), a major alliance of 73 member companies. Dr. Werner Kulcke, director of the HSI, calls the major objectives of the institute to develop new technologies and to ensure the prompt transfer from the scientific to the industrial communities.

"Microtechnology promises to be a truly exciting field in the years ahead," says Günzler, "and it's potential for revolutionizing the way we live has finally caught the eye of the general public. For example, a recent article in Germany's prestigious news magazine, *Der Spiegel,* profiled some of the most recent advances in the field, including microminiature electric motors, sensors and probes for the medical and health care industries and similar devices. HSI conducts applied research in microstructure and microsystem technologies, assembly and packaging techniques, surface technologies and signal processing. The transfer of practice-oriented solutions to problems in the field of microsystem technology is our top priority. Our Micromechanics Services Centre supports this goal by providing a wide range of technical and scientific support, thus enabling the introduction of new high-tech products to the mid-sized industry. We are very active in the consulting field, as well as in the evaluation of new literature and patents related, and constantly exchange information with industrial partners in order to evaluate new applications for micromechanical devices. We cooperate closely with the members of the HSG, the University of Stuttgart, and Germany's VDI/VDE Technology Centers in Berlin and Düsseldorf, as well as many other organizations active in the field."

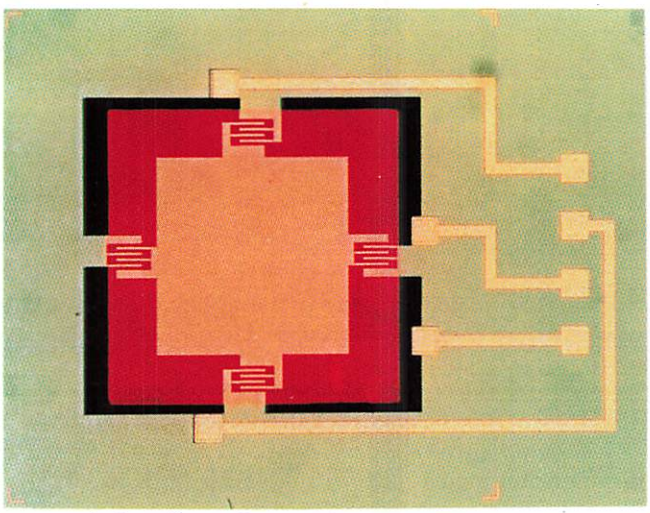
Hahn - Schickard - Institute in Villingen

To support these activities, the Villingen site includes application laboratories, a modern computer network for layout and simulation and workshops. A substantial library with modern data-basing of patent, product, literature and other fields can be accessed by researchers and industry. New laboratories are scheduled for completion in the third quarter of 1992 and will feature a class 10 - 100 cleanroom area more than 600 square meters in size. Cleanroom facilities are presently located in Erlangen and Stuttgart and comprise facilities for fabricating micromechanical devices, including installations for double - sided photolithography and micromachining of silicon and quartz using advanced laser processing and anisotropic etching. When expansion will be completed, HSI is expected to employ a highly-qualified staff of 70 to 80 employees.

A number of ongoing projects illustrate HSI's integration of microsystem design and technology with the fields of micromechanics, microoptics and microsensors and actuators. A joint project supported by the German federal government's Ministry for Research and Technology and including four major industrial partners is currently engaged in the development of microminiature sensors. These sensors will be capable of measuring and evaluating a wide range of process parameters such as pressure, temperature, humidity, etc. They will directly supply digital or quasi-digital output signals utilizing miniaturized resonators based on either piezoelectric quartz substrates or silicon substrates with piezoelectric thin films, e.g. ZnO.

Another internal project has succeeded in realizing a number of variable geometry pressure sensors whose sensitivity and other important parame-

pressure sensor



1x1 mm² membrane, piezoresistive readout, full bridge, connected by diffusion

ters are currently tested. The development of miniaturized actuators, including microvalves, pumps and switching elements, is also being currently under investigation.

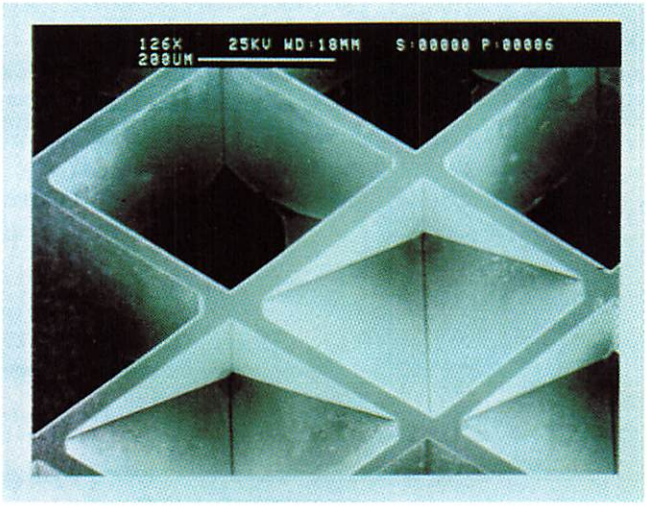
"In a further research project directly commissioned by the chemical industry," continues Günzler, "HSI has succeeded in developing a microstructure consisting of a microchannel suitable for the electrophoretic separation of fluid components. The channel, including two miniaturized metal electrodes designed to supply or measure potential differences in the channel, is anodically bonded to a glass substrate. This is an excellent example of HSI's development of an innovative new product based on hard-won scientific and technical know-how. It is not always necessary to develop a complete microsystem to help secure an industry's competitive advantage. The integration of a miniaturized component in an existing product or process is often a very important step in improving overall product quality."

Another important activity of the HSI is the specialization in laser micromaterial processing, combining laser processing techniques with more conventional anisotropic etching techniques. Micromechanical structures in silicon are normally fabricated using photolithography and anistropic etching. Although the size of the pattern on the silicon wafer substrate is defined by the masking layer, the shapes of spatial microstructures are limited by the formation of low-etching crystal planes. Therefore only certain types of geometric structures can be generated inthe silicon substrate. HSI's new technology utilizes lasers to destroy unwanted crystal planes and follow-up anisotropic etching of the resulting molten zones. The aspect ratio of microchannels in the silicon substrate can be effectively modified by the parameters of the laser beam. The partially closed form of the resulting microchannels makes them suitable for the precise positioning of fibers in hybrid microoptical devices and as microminiature transport systems for gases and liquids. Vertically walled honeycombed structures produced with this method can also be used, for example, as microwave band pass filters. Other applications include advanced substrates for use in scanning tunnel (atomic force) electron-microscopy.

"These are but a few examples of HSI's current projects and research activities," concludes Günzler. "But equally important is our function as a clearing-house for the transfer of technological know-how. Our project results are made available to all participating partners as well as to the general public and industry in the form of seminars, colloquia and a variety of publications. Our "Microtechnical Documentation" is published monthly and includes twenty articles giving an up-to-date overview of developments in the field of microtechnology. Subscribers save both time and money otherwise used in procuring and evaluating expensive specialized literature. And we are very interested in consulting with small- and mid-sized firms wishing to make use of the new developments in microtechnology.

Our Micromechanics Services Centre provides services ranging from data-base searches to system design, process implementation and feasibility studies, backed by our technological infrastructure, scientific resources and hard-won experience. We welcome inquiries regarding the innovative aspects of this exciting new technology." ■

combination of laser micromachining and anisotropic etching



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Reprint from TECHNOLOGY NEWS INTERNATIONAL; Issue April 1992.