Backgrounder

Infineon's Biochip Activities

New technologies create new markets:
Biochips combine semiconductors and biotechnology

Biotechnology will change life in the 21st century at least as radically as information technology did in the 20th century. In medical applications, robotics, computer science and microelectronics will enable new analytical methods that considerably increase efficiency in areas such as pharmaceutical research, diagnosis and ultimately, patient care. These new methods will change the equipment used in pharmaceutical labs to about the same extent as PCs changed the world of computing two decades ago: Everything used in the lab will become smaller, faster and more affordable. Leveraging its know-how in producing micro-scale chip structures at the highest quality in large numbers, Infineon is a driving force in this development.

In the solutions business within the semiconductor industry, the standard for Infineon's development efforts is no longer what is technically possible but rather the specific requirements of people. Infineon presented this new objective in September 2002 with its "Agenda 5-to-1" that focuses on technical solutions. Only a few months later, Infineon now presents the first complete systems solution: the Flow-Thru biochip system. Infineon offers the pharmaceutical industry a system platform for ever more powerful research methods that permit the cost-effective development of drugs and efficient diagnostics.

What are biochips?
Biochips are very small sample substrates made of glass, plastic or silicon. They permit the simultaneous execution and evaluation of hundreds or even thousands of biochemical reactions.

Optical and electronic biochips differ in their principle of operation.With optical biochips, sections of DNA from known genes are applied in precisely defined places and are

Infineon Technologies AG
Media Relations: Monika Sonntag
Phone: +49 89 234-24497, Fax: -28482
monika.sonntag@infineon.com

chemically attached to the substrates. The samples to be examined are then applied, after being marked with a specific substance. Matching molecules that fit like a key into a lock will bind to the fixed DNA strands. This natural process is called hybridization. All non-bound sample molecules are then washed off. The bindings are detected by means of a marker, such as a luminescent dye that is split up by an added enzyme, which causes it to release light. The light is recorded by means of a CCD (Charged Coupled Device) camera and evaluated by measuring device in a fully automatic manner. This detection method is called chemiluminiscence.

Promising Biochip Market

Biochips will find broad application shortly. Based on the market research results 2001 of the U. S. American Freedonia Group, Infineon expects the worldwide market, including biochips, hybridization units, evaluation apparatuses, and services like bioinformatics, to grow from 580 million US-Dollar in the year 2002 up to 4 billion US-Dollar in the year 2009. This results in a compound annual growth rate (CAGR) of about 32 percent. In the year 2009, the segment drug development is expected to amount up to two thirds of the whole market.

Infineon's Biochip Activities At A glance

Infineon is currently working on three different biochip system solutions to meet a wide range of customer requirements: the optical Flow-Thru Chip, the DNA biochip with electronic evaluation and the Neuro-Chip that is equally based on an electronic principle of operation.

Infineon's Optical Flow-Thru Chip

Infineon is currently the only company worldwide that is able to produce silicon-based biochips that are manufactured by means of a special etching process. Brought to market for the first time in the beginning of 2003, this biochip enables advanced analysis and screening methods that can shorten the development cycle of drugs by two or three years.

The optical Flow-Thru-Chip™ is the core of the complete system solution called the 4D Array System™. Flow-Thru biochips exist in different versions for the examination of inflammation, breast and lung cancer as well as degenerative phenomena of the nerve system such as Alzheimer's disease, Parkinson's disease and Multiple Sclerosis. Systems for the examination of liver diseases, programmed cell death (apoptosis) and

Infineon Technologies AG
Media Relations: Monika Sonntag
Phone: +49 89 234-24497, Fax: -28482
monika.sonntag@infineon.com

cardiovascular diseases will also be available shortly. In addition to these standardized chips, it is also possible to build chips on the basis of customer specifications and to configure them with the specific genes to be examined.

To manufacture the optical biochip, Infineon makes use of a special process that includes the high-precision etching of tiny perpendicular pores into the silicon substrate. These pores are about 10 micrometers in diameter, which corresponds to about one tenth of the thickness of a human hair. Up to 400 known, gene-carrying DNA sections are applied to precisely defined locations on the pore walls.

The hybridization of the sample to be examined is done by means of the so-called Flow-Thru technique. In this process, the sample to be examined is repeatedly pumped through the chip, which accelerates the hybridization period to about two hours and also improves the sensitivity and accuracy of the assay. It also reduces the necessary amount of samples and reagents. The complete Flow-Thru system solution includes a hybridization unit and an evaluation unit with integrated high-sensitivity camera; it is priced at about 60,000 euros.

Infineon's system partner for the Flow-Thru biochip system is the U.S. company MetriGenix, Inc. MetriGenix applies the respective DNA sections on Infineon's Flow-Thru Chip, encapsulates the chip in a special plastic package and manufactures the hybridization and measuring apparatus. The two companies have joined forces to market the system: Infineon is presently active in Germany, Austria, Switzerland and Scandinavia, while MetriGenix operates in the U.S. About 30 Flow-Thru Chip systems have already been sold.

Infineon's electronic DNA biochip

The electronic biochip is now undergoing the clinical test phase. It will probably be ready for market launch in two or three years. Its main field of application will be clinical diagnostics and patient-specific medication. For example, the analysis of a sample from a patient can show if this patient carries a specific disease. Additional techniques will also show how a patient responds to certain drugs. This allows the physician to determine exactly the right medication for a patient. The robust and easy to handle electronic chip could even make it possible for such examinations to be performed in any doctor's office through the simple application of a drop of blood.

Infineon Technologies AG
Media Relations: Monika Sonntag
Phone: +49 89 234-24497, Fax: -28482
monika.sonntag@infineon.com

The detection method used by the electronic biochip differs from the method that is used by the optical chip. Here, the substances to be examined are marked with an enzyme. To enable the detection, a substance is added, which splits up the enzyme into two electrically active components. The resulting flow of current is measured by sensors that are equipped with gold electrodes. The time characteristic of the current indicates the concentration of the respective substance.

In developing the electronic chip, Infineon cooperated with partners within a program sponsored by the German Federal Ministry of Education and Science, BMBF: Eppendorf, FhG ISIT (Fraunhofer Gesellschaft, Institute for Silicon Technology), November AG, and Siemens AG.

Infineon's Neuro-Chip

Infineon's Neurochip is a breakthrough development already being applied in brain research. For example, it enables neurobiologists to analyze how single cells or groups of interconnected cells respond to electrical stimulation and specific substances. To investigate the interaction between different areas of the brain, single nerve cells are applied that grow into neural networks on the chip surface. The cell tissue is not damaged during the examination and can be kept alive for several weeks. This provides neurobiologists with an insight into how the mind works and how things are perceived and memorized by the human brain.

The Neuro-Chip was a joint development with the Max-Planck Institute for Biochemistry in Martinsried near Munich. 16,384 highly sensitive sensors are contained in one square millimeter of chip surface. Each of these sensors collects at least 2,000 electrical signals per second from the nerve cells, amplifies these and forwards them to a computer system for evaluation. In this scheme, each nerve cell, covers at least one sensor. The spacing between sensors is less than eight thousandths of a millimeter, which is less than the diameter of a neuron (10 to 50 thousandth of a millimeter).

Research, development and production: The right location as a key to success

The development and production site as well as the headquarters for Infineon's optical biochips is Munich. Infineon's enabling research division, which is also responsible for the activities for electronic biochips and the Neuro-Chip, is also located in Munich, where the electronic biochips are also produced.

Infineon Technologies AG
Media Relations: Monika Sonntag
Phone: +49 89 234-24497, Fax: -28482
monika.sonntag@infineon.com

Relevant Web sites – Comprehensive information around the clock

Information about Infineon's biochips can be found at www.infineon.com/bioscience

Status: March 2003

Infineon Technologies AG
Media Relations: Monika Sonntag
Phone: +49 89 234-24497, Fax: -28482
monika.sonntag@infineon.com