MiPlaza – bridging the gap between bright ideas, innovation and practical results

Biochemical assay development in MiPlaza

Nanotechnology is not new. The semiconductor industry has been involved in it for years, fulfilling a prediction first made in 1965 by Intel co-founder Gordon Moore that the number of transistors on a silicon chip would double roughly every two years. Today, many of the structures inside silicon chips are of true nanometer proportions. The semiconductor industry therefore knows a lot about making things small. Provided, of course, that they are based on silicon. The problem is that many nanotechnology devices need more than silicon. In addition, much of the expertise surrounding the materials and mechanisms underlying operation of these new devices lies in academic institutions and start-up companies that cannot afford the expensive equipment needed to prove their ideas and industrialize their technologies. Which is why MiPlaza, an open-innovation initiative of Philips Research on the High Tech Campus in Eindhoven, the Netherlands, is bringing advanced cleanroom facilities, a fully equipped materials analysis lab, state-of-the-art prototyping expertise, leading-edge test and measurement facilities and technical support within the reach of small, and not so small, companies and research organizations.

By Peter Harold

Illustrations/photography: Philips, Storm Scott, Michel Klop

MiPlaza

Nanotechnology promises to create a whole new class of devices, from biosensors that can detect the early onset of disease and on-chip gyroscopes that can monitor the slightest movement of your hand to ultra-thin display concepts that rely on fluidics. However, development of these new devices involves a multi-disciplinary approach in which much of the knowledge base still lies in academic institutions, small- to medium-size enterprises (SMEs) and research groups. Bringing together that knowledge with the R&D infrastructure needed to perfect it and industrialize the results is what MiPlaza is all about.

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>
> Gerjan van de Walle, Business Development Manager of MiPlaza

Incorporating a 2650 square meter cleanroom, parts of which meet class-100 requirements (less than 100 half-micron particles per cubic foot of air), MiPlaza provides a comprehensive set of equipment and processes needed to create chip-scale devices or large-area electronics. As such, it ranks as one of the largest multi-purpose research cleanrooms in the world. MiPlaza users also benefit from the services of highly professional cleanroom staff, all of whom have considerable experience in advanced industrial practices.

The cleanroom is complemented by a materials analysis laboratory where experienced analysts examine molecular and structural detail, perform chemical analyses and characterize thin-film structures using an extensive toolbox of chemical and physical analysis equipment. There is also a reliability and lifetime testing laboratory where devices can be stressed to their limits, and a well-equipped electronic test and measurement laboratory. MiPlaza’s electronic engineers and software specialists can also assist in building complete product prototypes. And recently, facilities for working in the medical area of molecular imaging and diagnostics have been added.

Small Autonomous Networked Devices (SAND)

A good example of the MiPlaza team's ability to assist in the prototyping of new devices can be seen in the production of Philips Research's 'Intelligent Rings'. Just 14 mm in diameter and 1.5 mm thick, these Intelligent Rings allow a building block approach to SAND development.

Small System-in-Package modules, each containing specific functionality, allow a building block approach to prototyping Small Autonomeus Network Devices

Each ring contains specific functionality, such as a sensor, a DSP (digital signal processor) or a low-power wireless link. The rings simply stack together to create the required system with two end-caps hermetically sealing the finished device.

Applications already being investigated for these SANDs include unobtrusive body sensors for in-home patient monitoring systems.

Holst Centre

The Holst Centre currently uses MiPlaza's facilities in two research programs – one into the development of generic technologies and technology platforms for wireless autonomous transducer solutions, and the other for the development of systems-in-foil.

Developing ultra-low power wireless transducers that can scavenge energy from their surroundings and hence eliminate the need for batteries is seen as critical to building intelligence into everyday objects, allowing these objects to communicate with one another in intelligent networked environments. The development of systems that can be integrated into foils, preferably using techniques more like the reel-to-reel processes used in the printing industry than the wafer-based techniques used in the semiconductor industry, is seen as the only way of reducing the cost of these systems to the point where they become ubiquitous.

Open innovation

With all these fabrication, inspection and prototyping facilities and services under one roof, MiPlaza could operate as a foundry based on a conventional 'you design it, we'll make it' approach. That, however, is far from what MiPlaza is about.

Instead, MiPlaza operates in a spirit of open innovation where scientists and engineers from many different corporate organizations, start-up companies, SMEs and research institutes can work together in the areas of microsystems, nanotechnology and life sciences to turn their ideas and innovations into practical success. By making itself accessible to large and small organizations, MiPlaza provides an excellent basis for market-driven interdisciplinary research carried out in the spirit of cooperation for which the High Tech Campus Eindhoven is already well known.

For some companies it is that openness of the High Tech Campus, as well as the existence of the MiPlaza facility, that is the real benefit.

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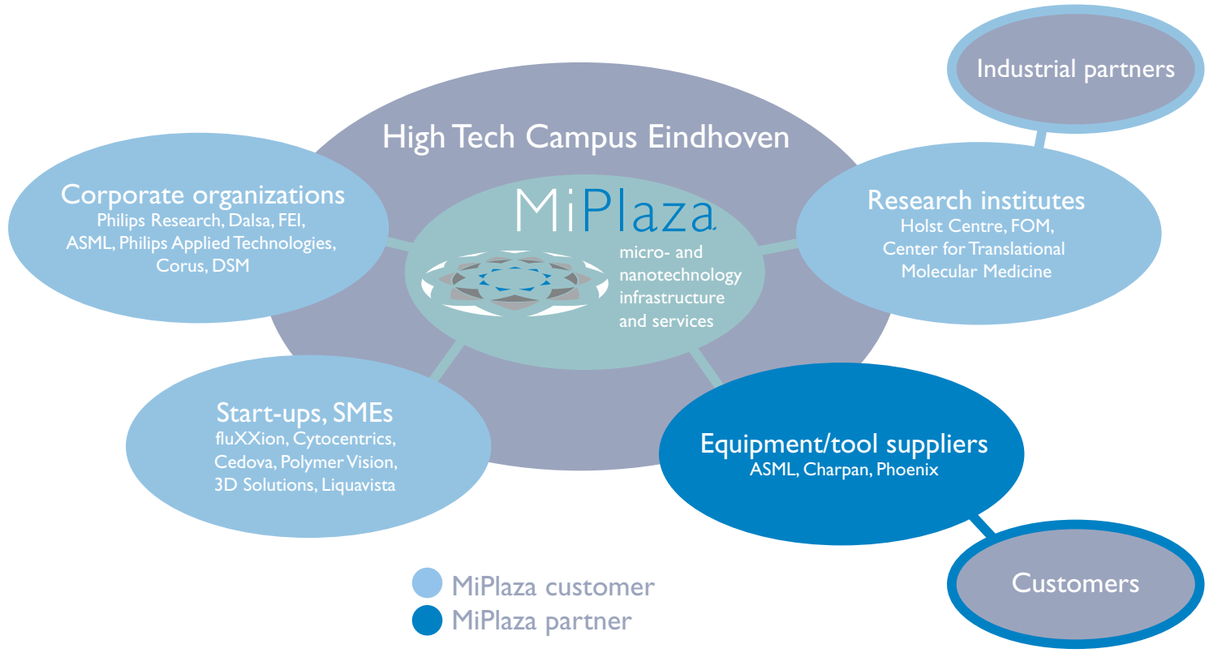
"In addition to giving us access to cleanroom facilities that would otherwise be unaffordable for a start-up company, the availability of offices on the campus that are within a few minutes walk of the MiPlaza labs allows an extraordinary level of interaction between our researchers and the cleanroom engineers," says Johan Feenstra, Director of Systems Engineering at display start-up Liquavista. "As a result, we can learn from and improve the fabrication process and test our prototypes in the reliability lab so that we troubleshoot problems extremely quickly."

Another company, opto-electronic device foundry Cedova, highlights the financial advantages. "Setting up our own foundry would have involved tens of millions of dollars of up-front investment in equipment and buildings which would initially be under-utilized," says John Reid, Cedova's Chief Executive Officer. "MiPlaza lets us buy only the capacity we need, which means we can expand our own foundry when we have the business to support the investment."



MiPlaza at the High Tech Campus Eindhoven, the Netherlands, enables a value network with private and public innovation leaders

For other companies it is MiPlaza's open-minded approach and willingness to entertain new ideas that has opened the door to business opportunities.

"If we had approached a large semiconductor company and asked it to produce beer filters we wouldn't have been taken very seriously," says Thijs Bril, Chief Executive Officer at microfiltration company fluXXion. "By using MiPlaza's facilities to prove that fabrication of our silicon wafer filters was well within the process technology envelope of commercial wafer fabs, we were quickly able to gain credibility."

MiPlaza also holds out opportunities for high-tech equipment manufacturers, as a result of which it contains some of the world's most advanced wafer processing, analytical equipment and test and measurement facilities.

"By installing one of our wafer steppers in the MiPlaza facility, we get valuable feedback on usage requirements plus the ability to test-bed new equipment options in an active cleanroom environment," says Jean-Paul van den Heuvel, Manager for Field Application Development at ASML Special Applications, the world's leading provider of lithography systems for the semiconductor industry. "But most of all, we regard the investment as worthwhile just to familiarize a whole new generation of potential customers with our equipment."

Building networks

For other organizations, MiPlaza is not so much about developing products or test-bedding their equipment as it as about putting together bigger research networks.

The Holst Centre, a joint collaboration set up between IMEC (Interuniversity MicroElectronics Center) in Belgium and Dutch

Cedova

Cedova operates a foundry service for the manufacture of optoelectronic devices, for example, lasers and photodiodes, based on so-called III-V semiconductor materials such as Gallium Arsenide, Indium Phosphide and Gallium Nitride and covering the infra-red and red, green and blue visible parts of the spectrum. The manufacture of these devices requires highly specialized knowledge of crystal growth, optical structures and coatings. Cedova leases space in the MiPlaza cleanroom for its own equipment as well as purchasing capacity in MiPlaza for processes such as lithography and optical coating.

fluXXion

FluXXion, one of the first users of the MiPlaza facility, uses lithography and plasma etching technologies borrowed from the semiconductor industry to produce billions of extremely well-defined pores in 1-µm thick 150-mm diameter silicon wafers to create highly efficient filters for extracting particles from fluids. With pores that are only one millionth of a meter from end to end, these filters require far less pressure than conventional filters in order to push fluids through them. Exceptional consistency in the size and shape of the pores makes them highly selective. Pores sizes as small as 0.45 µm allow fluXXion's filters to filter out single-celled organisms such as bacteria or even large viruses. Commercial trials are already underway on the large-scale filtering of beer and milk. Miniature versions of the filters could also find use in medical applications, such as the purification of blood plasma or as selective filters for biosensors. After successfully prototyping its filters in the MiPlaza's facility, fluXXion has now transferred pilot-line production to a commercial wafer fab.

industrial research and development organization TNO, is using MiPlaza as one of the key laboratories for its shared research activities with participants from industry and universities.

IMEC, already recognized as Europe's leading independent research center in the field of microelectronics and nanotechnology, focuses mainly on semiconductor process technologies that contribute to 'More Moore' – the ever-increasing integration density on silicon chips. However, the embedded systems of the future that will help to bring sense and simplicity into peoples lives, and ultimately realize the vision of Ambient Intelligence, will need more than just the 'brains' provided by these chips. They will need a whole new range of sensors and actuators, the equivalent of 'eyes, ears, arms and legs', in order to sense and respond to what is going on around them. These sensors and actuators lie in an area that has come to be known as 'More than Moore' and it will be in the MiPlaza facilities where the Holst Centre will focus its attention on their development.

Describing MiPlaza in a single sentence is not easy. As illustrated, it is different things to different people. For some it's a prototyping facility, for others a pilot production line, and for yet others a place to demonstrate or test-bed their equipment. MiPlaza also represents an experiment in different business models. At one level, users can simply buy the services they need, but at another they can contribute their IP (Intellectual Property) or resources to expand the services that MiPlaza offers and take a share of the value that is generated in the ecosystem of innovation around MiPlaza. It is not only open innovation in technology. It is open innovation in the way people work together.

MiPlaza has already attracted a wide selection of users. It's up and running on a vibrant new campus and it's already delivering results.

"As Europe moves into the new era of system-in-package, nanotechnology and life sciences, together with all the economic activities and societal benefits that it will bring, MiPlaza has rapidly established itself as one of the leading centers enabling the necessary research and development," says Dr. Gerjan van de Walle, Business Development Manager for MiPlaza. "By bringing together innovative people from both the public and private sector, and supporting them with the technologies and services needed to realize their ideas, MiPlaza is already playing a vital part in keeping Europe at the leading edge of the nanotechnology revolution."

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Extra info **www.research.philips.com/password** • MiPlaza • open innovation

Collaboratory.nl - the 'virtual lab'

Much of nanotechnology relies on the microscopic structure of materials and thin films that can only be inspected with the aid of highly complex and expensive equipment such as electron microscopes and spectrometers. However, ownership of this equipment is beyond the financial resources of many

Material analysis in a virtual lab

companies and academic institutions involved in nanotechnology research. Collaboratory.nl, a joint project between Telematica Institute, Philips, Corus, DSM, FEI Company and the University of Amsterdam, is addressing the problem by developing the information and communications technology required to create a 'virtual laboratory' in which scientists anywhere in the world can send samples of their devices to MiPlaza and view microscopy and spectroscopy images in real-time via the Internet. Already operational on MiPlaza's transmission electron microscope (TEM) and X-ray photoelectron spectroscopy (XPS) machines, the system allows users to guide the machine operator to zoom in on areas of interest and to 'conference-in' experts from around the world. For those that can prove they have the expertise to do so, it even allows remote users to directly control the machines.

Liquavista

Liquavista, a venture capital funded start-up company located on the High Tech Campus in Eindhoven (the Netherlands), develops low cost, ultra-low power displays based on the electrowetting principle. Comprising an array of sealed pixels, each containing water together with a minute drop of an immiscible colored oil, these displays rely on the fact that an electrical potential applied across a normally hydrophobic layer on the rear internal surface of each pixel causes the layer to become hydrophilic. As the water now wets the layer, the oil is displaced to one corner of the pixel and the pixel becomes transparent. Driven by active-matrix TFT (Thin-Film Transistor) back-panels similar to those used in LCDs, Liquavista's displays switch at video speeds and

are up to six times brighter than conventional LCDs and up to ten times more power efficient. Liquavista uses MiPlaza's optical lithography, thin-film deposition and reliability testing facilities to prototype its displays and industrialize its process technology.