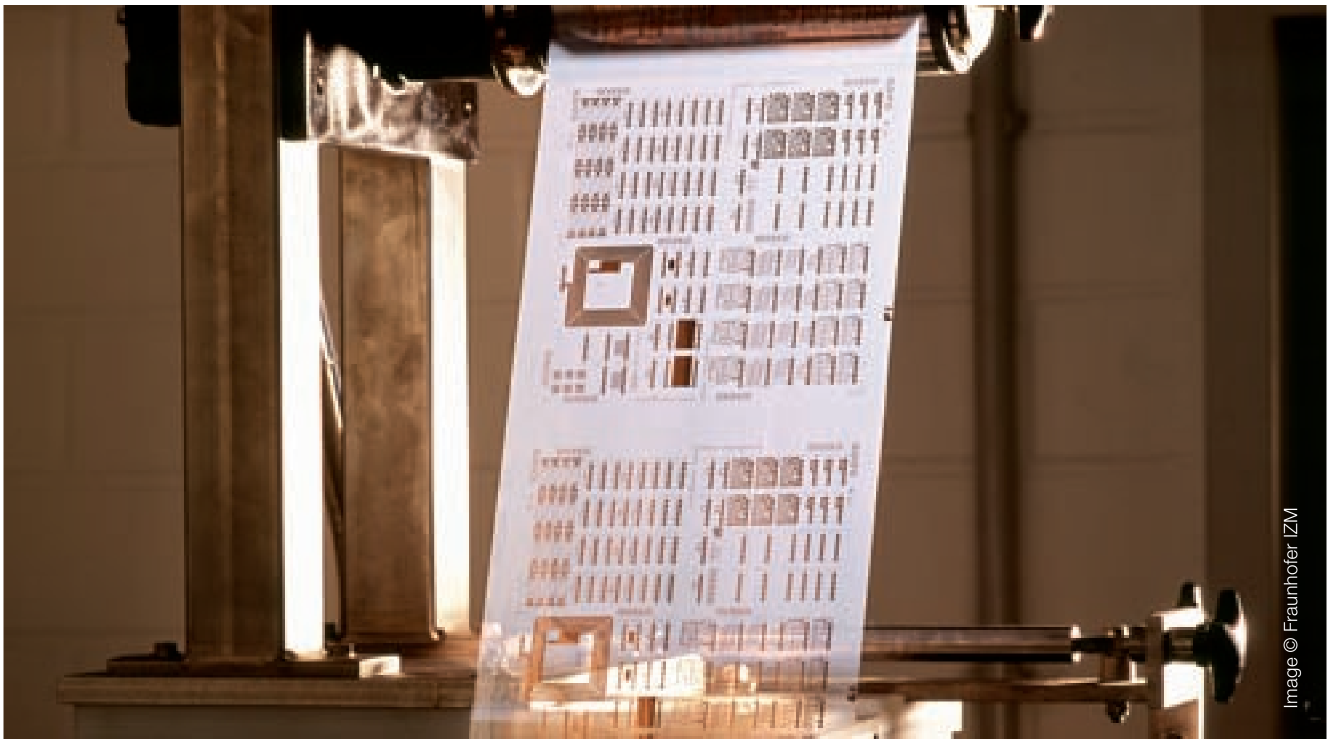

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# SHIFT:
# Smart High Integration Flex Technologies

Developing the smart, high-integration, mechanically flexible electronic systems for truly ambient intelligence is at the cornerstone of the SHIFT project. **Professor Jan Vanfleteren**, who leads the research, explains how the team is working hard to achieve its vision for the future

SHIFT has a very clear vision of the future, a future of "ambient intelligence" when more and more electronics systems will accompany every one of us.

These electronics systems will be on or near the owner, either near the body (e.g. portable communication systems), on the body (e.g. smart textiles), or even inside the body (implants). They will have to communicate with each other and with systems, which are fixed in the ambient.

> The objective of the project is to develop smart, high-integration, mechanically flexible electronic systems for a wide variety of applications

It is clear that the "carry-along" electronic systems should not hamper the comfort of the human "carrier" too much or, in a perfect world, not be noticeable at all. With this in mind, these devices must be lightweight and compact, must preferably take the shape of the object in which they are integrated, must be highly functional and be available at a reasonable price.

For this reason the logic evolution will be such that present rigid electronic substrates and assemblies will be replaced by flexible counterparts. This trend is just starting and will become stronger in the coming years. To boost the combination of high functionality, compactness and comfort, there is a strong need for substantial technology developments on flex technologies. This is exactly what SHIFT is aiming to do.

## Objective

The objective of the project is to develop smart, high-integration, mechanically flexible electronic systems for a wide variety of applications. "Smart" means that the flexible, multilayer laminate has embedded components, and that the different flex layers in the multilayer structure can have different functions, meaning that it might be necessary to combine layers of different base material in the laminate. Compactness of the resulting circuit is boosted in two ways:

- By using the third dimension for electronic component integration (not only on front and back side, but potentially on every conductive layer)
- By drastically increasing the wiring density through the introduction

of new flex manufacturing and lamination techniques

## Project highlights

In order to achieve the final goal of smart, compact flex assemblies, a logical build-up of activities is executed in the project. In the first place a number of standard and innovative multilayer flex technologies are developed. These include:

- Multilayer fine-line flex, based on standard laminates. These flex substrates are being developed by Freudenberg-Mektec in Germany.
- New multilayer flex lamination technology using solid state diffusion technology, leading to highly reliable compact multilayer flex substrates, developed by Thales Airborne Systems in France.
- Ultra-foldable fine-pitch flex (HiCoFlex), based on spin-on polyimides and thin-film technology, developed by Hightec in Switzerland.
- Cost-effective processes are under development for conventional laminates (reel-to-reel, Fraunhofer-IZM in Germany) and Large Area Processing for the HiCoFlex technology (development by Acreo in Spain).

Next to the flex substrate technology activities several innovative technologies for the embedding of components are under development:

- Embedding of passive components: printed resistors, capacitive layers (Fraunhofer-IZM, Thales Airborne Systems, TU Berlin in Germany).
- Embedding of thin chips (50µm) using die-bonding, flip-chip and lamination technologies (TU Berlin).
- Wafer thinning and die separation down to 20µm thickness of the Si dies, followed by packaging of this thin dies to an ultrathin foldable chip package (UTCP) of 60µm thick. The packaging is based on spin-on polyimides and thin-film technology. Wafer thinning is done by Fraunhofer-IZM, while the UTCP is developed by IMEC in Belgium.
- Development of thin-film flexible RF structures (striplines, resistors, capacitors, etc.) (Hightec, IMEC)
- Embedding of microwave active components (MMIC) in flex (Thales Airborne Systems, TU Berlin, IMEC), using LCP (liquid crystal polymer) as flex base material.

### Flex-Stretch Electronics Workshop

There will be an important dissemination activity called the "Flex-Stretch Electronics" workshop on flexible and stretchable electronic systems. The workshop, which is a joint organisation of the EC funded projects SHIFT and STELLA and the Flemish Community funded project BioFlex, will take place in Leuven, in Belgium, on September 6-7, 2007. For more information and registration visit http://www.imec.be/flex-stretch/

This means that on the one hand the emphasis of the project is on larger-area, cost-effective flex technologies while, on the other hand, also small-area, but high-performance components like RF structures and thin-chip packages are developed with higher cost per unit area than the flex technologies. The strength and unique feature of the consortium is now that the co-operation, established in SHIFT, allows for the combination of small, high-perfomance modules with cost-effective flex.

Embedding of RF structures or UTCPs in flex creates a high-performance, but still cost-effective flexible circuit. It is believed that in this way SHIFT develops unique technologies for high-performance, light-weight flexible and/or compact wearable electronic systems, and thus substantially contributes to the "ambient intelligence" vision.

Finally, components (SMD components, flip-chips, etc.) are assembled on top and back side of the multilayer flex. This is done on a sheet-by-sheet basis (IMEC, TU Berlin) but also in the reel-to-reel process (Fraunhofer-IZM).

Throughout the project the technological developments are being supported by modelling activities (electrical, mechanical, thermal and thermal-mechanical) and testing (especially reliability testing) in order to qualify the technologies, and facilitate the design of multilayer, embedded flex circuitry (IMEC) and Nokia, in Finland.

The technology developments are steered by the end users in the consortium, who define their requirements and specifications for their specific applications. End-users for a wide variety of applications are present in the SHIFT consortium. These include:

- Nokia: portable telecom applications
- Thales Airborne Systems: conformal antennas
- Oticon, DK: hearing aids
- Zarlink, UK: medical electronic systems
- IMEC: flexible radio circuits for wireless transducer systems

Currently the end users are designing their demonstrators, using the available base technologies, available in SHIFT. First demonstrators have been realised and are currently under evaluation, and the bulk of the demonstrators will be available at the end of the project, in December 2007.

A dedicated partner (VDI/VDE, of Germany) is responsible for the administrative co-ordination, training and dissemination activities in SHIFT. eS

*For further information visit: http://www.shift-project.org/*

Professor Jan Vanfleteren obtained his PhD in electronic engineering from the University of Gent (Belgium) in 1987. As a senior engineer at the IMEC, INTEC/TFCG Microsystems group he is involved in the development of novel interconnection, assembly and substrate technologies, especially flip-chip, adhesive and flexible and stretchable electronics.