

international newsletter on  
**micro-nano integration**

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A close-up photograph of a microfluidic chip. The chip is light-colored with a grid of rectangular reservoirs. The reservoirs are filled with a blue liquid. The text 'POLYNATUR 0,1% FETT' is printed on the chip. The chip is connected to a network of thin, blue, fiber-like structures. The background is a dark blue with a grid pattern.

# POLYMER MICROSYSTEMS

# Walpack Project: 3D Plus Received the 2007 EUREKA LYNX Award

3D PLUS received the 2007 EUREKA Lynx Award for outstanding technological and commercial achievement. This trophy was awarded for the highly successful EUREKA PIDEA Cluster WALPACK project developing high-density and 3D chip-stacking technology for cost-effective system-in-package devices. The award was presented at EUREKA's High-level Group gala dinner in Roma on June 13<sup>th</sup>, 2007 (see picture).

Innovative developments in wafer-level packaging and three-dimensional (3D) stacking in the WALPACK project have resulted in a highly cost-effective approach to system-in-package integration for extremely small electronic devices. This technology simplifies the combination of components in a single, ultra-thin module that offers high interconnection density, high data throughput and excellent reliability, while keeping low processing costs. The WALPACK technology is already being developed for key markets in space and high-end computing as well as mobile phones, high-capacity smart cards and biomedical devices.

The rapid reduction in the size of electronic devices –especially handheld products such as mobile phones, multimedial players and personal digital assistants– has been made possible by the equally fast miniaturisation of the electronic components inside. However, new packaging techniques are now needed to achieve the even higher levels of integration required, for example, to increase the processing power of smart cards or to develop miniature biomedical devices that can be embedded in the body.

So-called system-in-package (SIP) devices are one answer, combining a series of individually optimised integrated circuits such as memory chips, microprocessors and micro-electro-mechanical systems (MEMS) in one module. Miniaturisation can then be improved by vertically stacking these elements in a single polymer package.

## 1. Overcoming limitations

Major semiconductor companies have tried to achieve this by stacking complete wafers –each containing hundreds of separate chips or circuit dice– on top of each other, interconnected through holes formed in the silicon substrate. However, such an approach is limited to wafers from a single chip vendor, and with all the individual dice having exactly the same dimensions. Moreover, this wafer-stacking process is problematic because of the intricacy and cost of etching holes directly into the silicon substrates. In addition, productivity is often a nightmare as it is impossible to guarantee 100% known good wafers, resulting in very low global yields.

A more effective alternative method was therefore proposed by 3D PLUS, a spin-off from French defence electronics company Thales, set up in 1996 to exploit 3D interconnection technology for space and aerospace applications. It is the only European company to specialise in vertical stacking of electronic chips, interconnected by edge metallisation, as a cost-effective way of increasing component density to meet the ever-growing pressure for smaller yet higher performance electronic devices.

Together with processing and test equipment manufacturers, potential customers and research institutes in France and the UK, 3D PLUS decided to set up a EUREKA project to prove their approach. Note: the EUREKA label enabled 3D PLUS to put together the consortium faster and with less effort than under the EU Framework Programme. While the percentage of funding available through the EUREKA Initiative may be lower, building a consortium more easily is a major advantage.

## 2. High-yield process

The WALPACK process involves rebuilding wafers from different types of chips of any size and then stacking the rebuilt wafers inside an overall polymer package. Interconnections are made both internally, through



Christian VAL, 3D PLUS' CEO  
(Courtesy of EURIPIDES)

the polymer layers, and by laser-defined edge connectors.

A standard pick-and-place machine is used to assemble good dice on a sticky membrane and mould the resulting wafer in epoxy resin. Connections are made using a laser-etching technique on a conducting layer, rather than using a photoresist. The rebuilt wafers are then glued on top of each other and cured to make solid stack. "A typical six-layer module is some 600- $\mu$ m thick, but we can make stacks of up to ten layers", says 3D PLUS' CEO Mr Christian Val.

Advantages of this approach include the ability to use standard wafers from any manufacturer without modification – a major saving, as a mask set for photolithography can cost from 400,000 Euro to 600,000 Euro. Moreover, high yields are ensured as all chip dice are tested electrically and, if necessary, burned-in before stacking, ensuring a known good rebuilt wafer.

## 3. Technology being commercialised

Results of the EUREKA project are very promising with the proof-of-concept demonstrator fulfilling all its requirements. 3D PLUS has now taken the technology further, developing and optimising its process

through a joint development agreement with NXP (formerly Philips Semiconductors), which will manufacture modules for 3D PLUS as well as its own applications, mainly mobile phones.

These developments are helping 3D PLUS to diversify from its space and aerospace base into medical: micro camera 1/10" for endoscopy – see figure 1, memory modules – see figure 2, smart card, telecommunications and IP licensing fields.



Figure 1 – micro camera (Courtesy of 3D PLUS)

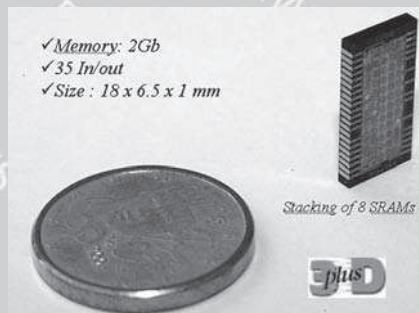


Figure 2 – memory module (Courtesy of 3D PLUS)

3D PLUS has also been working closely with other European companies to develop very high capacity smart cards for subscriber identity module (SIM) applications. These combine four Flash memories and a security ASIC within a 550- $\mu$ m deep cavity in the SIM card. There is a huge potential for such smart cards estimated to be around 200 million in 2009 and 400 million in 2010. And this market is already dominated by Europe.

Very high density Flash memories also have extensive commercial applications both for secured digital cards in all types of portable devices and to increase the memory capacity of mobile multimedia players.

Very ambitious projects to integrate numerous functions such as storage,

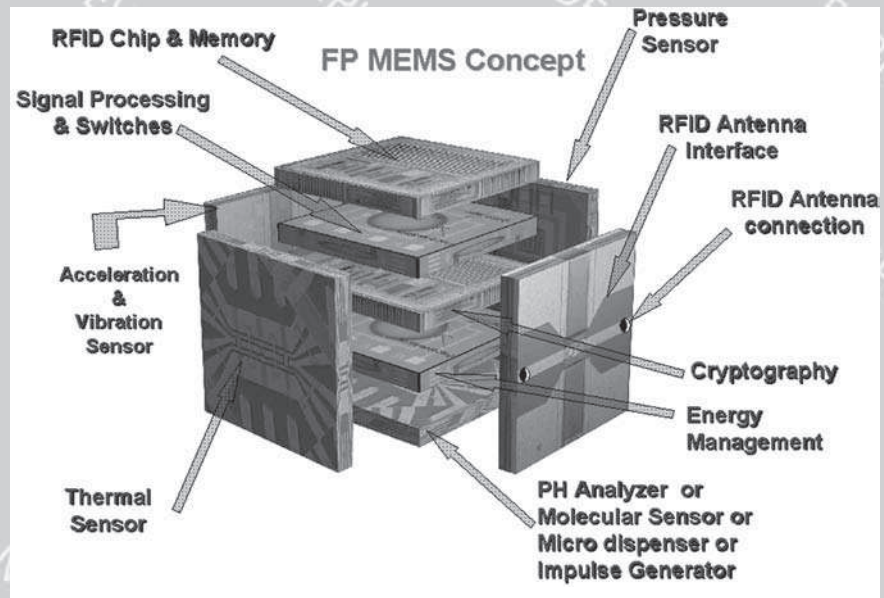


Figure 3 – FP MEMS concept (Courtesy of 3D PLUS)

computing, cryptography, communication, multi sensors, antenna, energy, etc, for medical and space (satellite-in-a-cube) applications are in progress –see figure 3.

#### 4. Contact

3D PLUS  
641 rue Hélène-Boucher,  
F-78532 Buc, France

Christian Val  
Tel.: +33 1 30 83 26 51  
Fax: +33 1 39 56 25 89  
cval@3d-plus.com  
www.3d-plus.com

#### 5. EUREKA achievements

The EUREKA Lynx trophy rewards a project leader company, whose proposal was labelled by one of the EUREKA clusters and whose project outcome is successful with technological achievements, commercial development and creation of health and jobs in the EUREKA area –composed of 37 countries plus the European Union. The success of the WALPACK project shows the interest of building up a project within the EUREKA programme and, more specifically, within one of its clusters. EUREKA supports R&D projects that are close to the market with at least two industrial partners from two different EUREKA countries.

The EURIPIDES initiative was launched in June 2006 by EUREKA after the merger of the former PIDEA+ and EURIMUS II clusters. The objec-

tive of EURIPIDES is to reinforce the worldwide position of European projects in the field of SSI (Smart System Integration). Thanks to EURIPIDES, European industries and their institutional partners have the opportunity to build competitive projects funded by their National Public Authorities with no limitation of applications provided that they are civilian.

The current EURIPIDES call for proposals was launched on June 1<sup>st</sup>, 2007 (see details on the website). The dates of the next call will be available soon.

#### EURIPIDES Contact

Email:  
euripides@euripides-eureka.eu

Web:  
www.euripides-eureka.eu

**EURIPIDES Office**  
17, rue de l'Amiral HAMELIN  
F-75783 PARIS cedex  
Tel : +33 (0)1 45 05 70 49  
Fax : +33 (0)1 45 05 70 37

**EURIPIDES Office**  
CEA - 17, Rue des Martyrs  
F-38054 Grenoble Cedex 9  
Tel : +33 (0)4 38 78 36 38  
Fax : +33 (0)4 38 78 56 70