Project profile

CATRENE

Cluster for Application and Technology Research in Europe on NanoElectronics

CT213 | Biosensor Platform will impact accuracy, speed and costs in healthcare diagnosis [3DFF]

PROJECT CONTRIBUTES TO

Communication	✔
Automotive and transport	✔
Health and aging society	✔
Safety and security	✔
Energy efficiency	
Digital lifestyle	✔
Design technology	✔
Sensors and actuators	✔
Process development	
Manufacturing science	
More than Moore	✔
More Moore	✔
Technology node	

Technology Platform for Process Options

Partners:

Toppan Photomasks (TPI)
Alphasip (ASIP)
BodyCAP
Hemosoft
Boschman (BT)
Advanced Packaging Center (APC)
Laboratoire de Photonique et de Nanostructures – (LPN))

Project leader:

Jose Luis Conesa
Alphasip

Key project dates:

Start: December 10, 2012
End: November 30, 2016

Countries involved:

Spain
France
Turkey
The Netherlands

Unsurprisingly, diagnosis costs are rising in (developed) countries with aging populations. That is why healthcare institutions are understandably seeking ways of deploying new technologies to produce an economic, fast and accurate diagnostic system to help reduce overall diagnostic costs. The foundational biosensor platform the 3DFF project will deliver fits the bill nicely. Based on a flexible substrate, the biosensor will ideally combine high performance with low cost.

The 3DFF project is developing a flexible sensor technology to provide accurate, fast, affordable and cost-effective biosensors with a broad range of applications: from security, in vitro medical diagnostics, to in vivo medical diagnostics. It is based on a flexible substrate that can integrate seamlessly microfluidic and microelectronics components and will form the basis of a disposable sensor, which will be complemented with a reader platform able to translate the sensor data into information that can be then presented to the users.

Onsite data collection and testing

Key 3DFF activities and deliverables are:

- Developing a technology to implement flexible biosensors, by integrating microfluidic and microelectronics components over biocompatible materials;
- Modelling, developing and characterising a flexible microfluidic device based on polymer materials and subsequently integrating it into a 3D generic analytical microsystem;
- Developing a wireless wearable patch capable of detecting biological components;
- Building a compact point-of-care (POC) analytical microsystem demonstrator capable of detecting different biomarkers (from cardiovascular markers to abused-drugs metabolites);
- Validating the analytical procedure and demonstrator in an environment close to a real-world environment;
- Developing several test cases to demonstrate the technology and help prove the performance that can be achieved with the developed technology, and at the same time showing its flexibility and broad use, since the test examples come from quite different application fields.

The three test cases used to demonstrate the results of the project will:

1. Detect the presence of abused drugs by using a saliva sample on a POC device;
2. Detect biomarkers in a blood sample to diagnose cardiovascular disease (CVD) using a POC device;
3. Detect different ions and biomarkers in sweat samples using a wearable wireless patch.

In the case of abused drugs and the CVD detector, the use disposable cartridges will allow for simplifying recalibration procedures (compared to non-disposable devices) and avoid cross contamination between samples. Concerning the wearable patch, it is 'initiated' by removing the protection strap from the biocompatible polymer and placing it directly on the skin. The piezo sensor provides heart-rate information and the biosensor provides target biomarker details through cumulative analysis of specific molecules present in the sweat. Crucially, the information collected is sent to a server, typically through a GSM network (usually deployed for mobile telephony).

Securing European semiconductors and electronics

In addition to advantages inherent in the project's technical, functional and economic objectives, there are also spinoffs that could benefit the semiconductor, healthcare and allied industries in Europe (and beyond). For example, there is the challenge of continued Moore's Law scaling and the ever-growing consumer demand for smaller, faster electronics with extended and new functionalities. 3D integration is a promising and fast-growing field that addresses the convergence of Moore's Law and more than Moore. 3D integration offers a path to higher performance, higher density, higher functionality, smaller form factor, and potential cost-reduction.

3DFF also supports the effort towards the development of a European system-in-package (SIP) supply-chain for innovative systems integrating advanced CMOS and European differentiating technologies through 3D and heterogeneous integration. The development of a 3D integrated microfluidic technology – a 3DFF objective – will enable the introduction of current requirements, such as multiplexing, flexible reception systems, miniaturisation and heterogeneous integration to SIP, allowing different application areas to benefit from this innovation.

Likewise, the innovative technology addressed in 3DFF, clearly targets the opportunity of promoting European leadership in the supply chain for 3D/SIP by taking advantage of the existing strong interaction between technology development and application domains (as 3DFF illustrates). This project will apply the developed technology in two application domains: roadside drug screening and healthcare in vitro diagnostics (POC device for D-Dimer detection).

Securing competiveness in three European healthcare sub-sectors – security, in vitro diagnostics and online monitoring – 3DFF seamlessly ramps up the concept from prototype (feasibility) through various designs in a single fabrication flow to mass fabrication. 3DFF will also create a large application field to produce chips that have the reliability, speed, pitch, and pin count necessary for optimal performance, including lower power usage, and a faster time-to-market.

The expected impact from the project results are of great importance, in view of the high market volume on which the project is focused. An accurate and cost effective POC test for CVD, for instance, will increase survival after a thromboembolism (a combination of thrombosis and its main complication: embolism) and also effectively reduce costs. POC use of CVD is gaining in popularity and had an estimated market of $ 830m in 2008. Thus, addressing a European Union market (27%) where stress and sedentary ways of life play such an important role in society, and a huge North American market (45%) makes good commercial sense.

European authorities are also strongly promoting road security, implementing strict policies against driving under the influence of drugs. The introduction of a reliable, low-cost, portable drug-screening device will highly decrease the amount of road traffic accidents. Global estimates suggest that the economic costs of road traffic injuries amount to $518 billion per annum. In developing countries, the costs are estimated to be $100 billion, twice the annual amount of development aid to developing countries.

And that is not all. 3DFF will introduce a positive synergy promoting the creation of new R&D projects involving companies and institutions participating in this consortium. Likewise, the knowledge acquired in this project will drive technological transfer, applicable in other areas. 3DFF will also promote the different R&D areas of this project consortium and foster new research lines. This will directly affect job creation linked to production and sales of demonstrators developed in 3DFF. In the long term, this technology could even increase European employment, creating more than 200 jobs for the manufacturing of these devices, and 100 jobs in research, administration, finance and sales.

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CATRENE (Σ! 4140), the EUREKA **C**luster for **A**pplication and **T**echnology **R**esearch in **E**urope on **N**ano**E**lectronics, will bring about technological leadership for a competitive European information and communications technology industry.

CATRENE focuses on delivering nano-/microelectronic solutions that respond to the needs of society at large, improving the economic prosperity of Europe and reinforcing the ability of its industry to be at the forefront of the global competition.