

PROJECT PROFILE

CAT802

Enabling reliable advanced microsystems based on MtM, SiP and 3D technologies for European core applications [SAM³]

SAM³ explores and develops new diagnostic tools and advanced methods for material characterisation, defect localisation, efficient sample preparation, physical failure analysis techniques and workflows. These are essential for producing reliable advanced microsystems for European core applications based on More-than-Moore, system-in-package and 3D high-density integration technologies.

More-than-Moore (MtM), system-in-package (SiP) and 3D high-density integration technologies are required for designing such compact microelectronic devices as those used in future Smart Cities. For these complex devices, new materials and processes must be developed and qualified. This requires effective analysis techniques to understand new failure modes and reliability-limiting factors caused by thermo-mechanical mismatch, residual stresses and interaction of new materials and processes. Existing failure analysis techniques are limited in localising electrical defects in these SiP devices with multi-level wiring. Efficient and artefact-free sample preparations to apply physical analysis techniques are also limited. This calls for techniques to determine local residual stresses and material parameters within the package for reliability modelling.

The answer is SAM³.

Towards more reliable advanced microsystems

Targeting European semiconductor and system suppliers, SAM³ aims at:

- Strengthening global competitiveness in designing and manufacturing reliable, high-quality and cost-effective MtM and SiP products;
- Building close cooperation between European Union (EU) semiconductor and system manufactures, as well as, EU failure diagnostic-tool suppliers in order to promote , innovative MtM and SiP products and adapted failure-analysis tools, and shorten product development cycle-times;
- Preparing proper failure-analysis workflows and material characterisation capability for advanced SiP product design to avoid technology failures in the early development phase;

- Implementing innovative failure localisation and analysis methods and tools in MtM and SiP developments to improve their reliability and thus reduce future field-returns and related costs;
- Developing innovative diagnostic and methods and tailoring them to conditions dictated by MtM (like wide band-gap semiconductors) and SiP devices, in order to identify and understand new failure modes.

Targeting diagnostic and equipment suppliers, the project aims at:

- Strengthening the global competitiveness of innovative failure-analysis tool-suppliers providing access to the most current MtM and SiP technology developments, and better tuning roadmaps to customer needs;
- Driving new equipment innovations by investigating novel approaches to material characterisation and failure diagnostics for SiP, supported by leading EU research institutes;
- Developing innovative diagnostic tools and methods to localise failures in complex wiring and material stacks of SiP devices; and enabling efficient target preparation and material analysis based on market needs, and the needs of EU semiconductor and system suppliers;
- Developing preparation and analysis techniques for new materials in microsystems (such as wide band-gap devices).

Improving development and production

Four major European semiconductor and system suppliers are collaborating with 10 equipment and analytical method suppliers from Germany and France. The work is further supported by five academic partners. This collaboration will strengthen the competitiveness of the semiconductor and system suppliers to design innovative MtM and

PROJECT CONTRIBUTES TO

-  Communication
-  Automotive and transport
-  Safety and security
-  Energy efficiency
-  Sensors and actuators
-  Process development
-  More than Moore

PARTNERS

Infineon Technologies AG
 Robert Bosch GmbH
 MUEGGE GmbH
 PVA TePla Analytical Systems GmbH
 Point electronic GmbH (SME)
 SmarAct GmbH (SME)
 WITec GmbH (SME)
 3D-Micromac AG (SME)
 STMicroelectronics Grenoble (ST Grenoble)
 STMicroelectronics Rousset (ST Rousset)
 STMicroelectronics Tours (ST Tours)
 Thales Systèmes Aéroportés (Thales SA)
 Thales Research and Technology (Thales R&T)
 Digit Concept
 Orsay Physics
 Predictive Image
 Sector Technologies SAS
 CNRS-DR12 (LP3)
 Fraunhofer-Gesellschaft (Fraunhofer-IMWS)
 Greman-Tours University
 LEPMI-CNRS
 Reutlingen University

COUNTRIES INVOLVED

-  France
-  Germany

PROJECT LEADER

Klaus Pressel
 Infineon Technologies AG

KEY PROJECT DATES

1 October 2015 - 30 September 2018

SiP products with respect to reliability, quality, cost and time-to-market, in order to ensure global leadership. The project will also support European analytical-equipment providers, many of them small and medium-sized enterprises, to explore new market opportunities, design new equipment, and align their developments to future needs of new system integration technologies.

A successful SAM³ project will improve the capability of semiconductor and system suppliers to avoid defects and failures during product development, thanks to better material understanding. The results of material characterisation, failure analysis and reliability testing provide the basis for direct improvement of the technological process during system development and device manufacturing, thus also reducing field-returns. Proper failure analysis will guarantee these companies secure the reliability and quality of new products, and ensure they meet their market-entry window. In addition, this project (3D-SiP in particular) will contribute to energy efficiency, as well as sensors and actuators.

Project results will also provide input for advanced simulation approaches or reliability models that can be used to identify and consider reliability problems already encountered during the product development phase. Such concepts are key to helping reduce time- to-market and development costs. In particular, comprehensive, well-adapted and effective failure-analysis workflows provide essential support for technology development, process and product qualification, and quality/ process control during fabrication. Proper analysis workflows can result in reliability assessments achieving short time-to-market readiness, proven application potential and future customer acceptance of innovative MtM, SiP and 3D integration solutions. A successful SAM³ project will also allow equipment suppliers, many of them small and medium-sized enterprises, to better understand the needs of semiconductor and system suppliers, and tune their roadmaps according to industry needs.

Focusing on employment, product creation and intellectual property

Crucially, this project secures the competitive power in several European industry sectors. Over the past decade, mass production of microelectronic devices, such as memory, has been moving out of Europe. However, automotive, security, power and communications sectors are still European strongholds, and Europe has a strong position in high-density complex SiP technologies.

In fact, the SiP market is growing, thanks to ongoing miniaturisation. 3D-SiP solutions are appearing in products and components in various sectors in which, for example, MEMS, sensors and other MtM devices are involved. This is already taking place today in the automotive and transport sectors, as well as in industry and communication (driven by mobile communication).

All of this makes it strategically critical for Europe to develop intellectual property in this emerging field to maintain existing employment levels, develop replacement products and reap financial benefits and wealth.

Finally, as a side note, through-silicon via (or TSV, a high performance interconnect technique) has now become the preferred interconnect choice for high-end memory, according to market-researcher, Yole Développement. This could be relevant because the TSV market is considered a SiP submarket since it involves the stacking of dice that need to be packaged.

Europe already has a strong equipment and metrology industry today. This project will create opportunities for equipment suppliers to further improve their products, and thus their competitiveness.

