

CT306 | Standards-compliant tools for 450mm production reinforces European semiconductor industry's position (NGC450)



The NGC450 project successfully delivered the necessary means to re-tool production lines to migrate from 300mm to 450mm wafer production, while still adhering to international standards and keeping costs down.

Common software and robotics platform drives 450mm wafer development & production

The move by leading chipmakers to abandon 300mm wafer production in favour of the larger 450mm ones will improve production volume and the yield of viable devices. There was, however, an initial downside: new equipment was needed to handle and process the larger wafers, resulting in much increased investment costs to build a semiconductor fabrication plant (commonly called a fab). In addition, such a transition required considerable research and development (R&D) effort and presented substantial technical and financial challenges.

Innovative and promising

The NGC450 project aimed at helping Europe develop a wafer-handling platform, dedicated to supporting the 450mm wafer size migration. The project was conducted in two phases: development of a wafer-handling R&D platform; followed by integration into a fab environment to assess its throughput versus a 300mm benchmark, involving the simulation of wafer processing times. All development work was compliant with the International SEMATECH Manufacturing Initiative (ISMI) standards and specifications.

NGC450's key achievements and deliverables can be summarised as follows:

- Atmospheric equipment front-end module with preliminary equipment for automated wafer-loading was developed, and a detailed state-of-the-art unit assembled for final characterisation

The challenge was in transferring heavier substrates through a longer distance within an equal period of time, despite increased vibrations phenomenon and more challenging mechanical properties of the substrate.

Atmospheric robotics were able to maintain the same throughput as a 300mm system, with optimal wafer safety and extreme cleanliness;

- Vacuum robot and a linear vacuum chamber, as well as, vibration-free, stiff and very thin end-effectors for atmospheric and vacuum environments were developed. The end-effectors fully comply with low defectivity, safe-handling efficiency and contamination (particle and metallic) demands. Viability to produce an easily scalable vacuum chamber while maintaining the same throughput as a 300mm cluster system was successfully tested;
- Compliance with 16-22nm cleanliness and airborne molecular contamination was proven. The efficiency and stability of the software to drive a multi-equipment cluster with a high-performance interface was tested;
- The project implemented specific vapour phase decomposition (VPD) and liquid phase decomposition (LPD) set-ups on 450mm wafer and optimised metallic contaminants collection coupled to the advanced inductively coupled plasma mass spectrometry (ICPMS) characterisations. The set-ups' efficiency and sensitivity were fully tested to characterise the contamination levels of the robotics;



Partners:

AIS
 ASYS
 CEA-LETI
 EVG
 Fraunhofer
 HAP
 Intel
 RECIF

Project leader:

Guilhem Delpu
 RECIF Technologies

Key project dates:

Start: November 2011
 End: December 2014

Countries involved:

Austria
 France
 Germany
 Ireland

- Specifications of the robotics and software to ensure compatibility between the wafer-handling platforms developed within this and other current projects;
- Specification review of cleanroom space and the logistics and fluids needed for the tools;
- Development, review and assessment of specifications necessary to support a silicon-on-insulator (SOI) production line.

Beneficial European collaboration

Crucially, NGC450 has helped to mitigate the technical and financial challenges that 450mm migration raises, as far as wafer handling and automation are concerned. This will help the European semiconductor materials and equipment industry to optimise R&D efforts and minimise related risks. The ultimate objective of NGC450 and its eight project partners from four European countries was to build a comprehensive package that will address 450mm challenges by allowing European companies to focus on a common target and share the same hardware and software interfaces. The development around a common software and robotics platform will share key skills and the risks, limit redundant development in robotics and automation and thereby limit overall R&D costs.

And the results are promising. According to one consortium member, this project delivered off-the-shelf, turnkey automation with fast throughput. All of this will help reduce the time to market for European-made 450mm enabling technologies and offer interoperability advantage to European equipment suppliers. It will also consolidate the European semiconductor equipment industry's global leadership position, with project partners expected to secure European competitiveness in the promising 450mm market.

Furthermore, a significant part of the R&D output will be dedicated to the improvement of current 300mm applications targeting the sub-20nm

technology node and focusing on cleanliness, throughput and yield improvement. This is, therefore, also an opportunity to sustain the European semiconductor industry in the existing 300mm market.

European and global sales opportunities

Equally important is the non-European market where European semiconductor production equipment and materials companies tend to score bigger sales. In fact, one project partner has secured more than a 25 percent share of the worldwide market in 300mm wafer sorters over the last decade. More than 90 percent of its turnover now comes from outside Europe (Europe accounts for only seven percent of its worldwide installed base of nearly 700 units of 300mm equipment).

NGC450 also presents valuable opportunities for Europe to establish and develop its own share of this global market, where American and Japanese equipment suppliers are already well established in this new 450mm segment. By providing these European enterprises the chance to co-operate to optimise R&D efforts and minimise related risks, this project helped reduce their time to market and provided them with an interoperability advantage.

Consistent, uniform and economical

NGC450 used the findings and results from the first ENIAC 450mm project (EEMI450 project). It will now act as a reference for subsequent 450mm projects. In the same way, some of NGC450's output will now be used by other related projects, like ENIAC EEM450PR, ensuring consistency and uniformity with preceding and subsequent projects which are part of the EEMI450 initiative. Importantly, it will also mean making excellent use of work already done, thus reducing project time, effort and costs.

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	<22nm



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