



# CT306 | NGC450 [NGC450]

## 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	<22 nm

## MANUFACTURING SCIENCE: CROSS-CUTTING TECHNOLOGIES, EQUIPMENT AND MATERIALS

### Partners:

AIS  
 ASYS  
 CEA-LETI  
 EVG  
 Fraunhofer  
 HAP  
 Intel  
 RECIF Technologies  
 Soitec

### Project leader:

Guilhem Delpu  
 RECIF Technologies

### Key project dates:

Start: November 2011  
 End: December 2014

### Countries involved:

Austria  
 France  
 Germany  
 Ireland

Considerable technical support is required for the move from 300 to 450 mm diameter wafers in semiconductor fabrication facilities. The CATRENE NGC450 project is developing a European wafer-handling platform to make this possible while meeting standards and specifications already established by the International SEMATECH Manufacturing Initiative. This work is in line with other CATRENE and ENIAC projects with the resulting synergy between European chipmakers expected to accelerate development and reduce costs. The modules and equipment resulting from this work will be available for worldwide use, so strengthening the role of Europe as a leader in the field of advanced semiconductor fabrication.

State-of-the-art wafer fabrication for integrated circuits (ICs) has been based on 300 mm wafers but a migration to 450 mm wafers is now planned by leading chipmakers as this offers a vast improvement in production volume and the yield of viable devices. However, new machinery is needed to handle and process larger wafers, resulting in much increased investment costs to build a semiconductor fab.

Moreover, a simple increase in equipment dimensions cannot satisfy the primary expectations of industry leaders to meet the main technical challenges, and achieve the same throughput as that of a 300 mm wafer fab with sub-22 nm node compliance. Such a transition requires considerable research and development (R&D) effort and presents substantial technical and financial challenges.

The combined energy of the companies involved in the CATRENE CT306 NGC450 project is expected to secure European competitiveness in the promising 450 mm market as a result of sharing key skills as well as limiting redundant developments on robotics and automation.

### Improving current lines

A significant part of the R&D output will be dedicated to the improvement of current 300 mm applications targeting the same 20 nm technology

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

The 300 mm IC manufacturing industry is today supported by state-of-the-art production equipment which benefits from mature and stable robotics with a sub-30 nm node capability. Migrating to 450 mm wafer size with sub-22 nm nodes poses challenges which cannot be addressed by current designs. For instance, robotics have to transfer heavier masses over longer distances within the same period of time and also cope with increased vibration and even more challenging cleanliness.

The 450 mm standards developments are supported by the Semiconductor Equipment and Materials International (SEMI) and Sematech organisations. First-level standards were published at the end of 2009 for test wafers, process wafers, carriers and load port. Earlier 2008 and 2009 standards focused on defining the physical interface and were dedicated to atmospheric robotics.

### Collaborative effort crucial

Project partners will each have specific responsibilities for:

- Systems analysis and high dynamic atmospheric robotics – deliverables will involve an atmospheric equipment front-end module with prelimi-



nary equipment made available for partners requiring automated wafer loading for process development, and a detailed state-of-the-art unit assembled for final characterisation;

- Development and construction of a vacuum robot and a linear vacuum chamber;
- Development and construction of end effectors for both atmospheric and vacuum environments;
- Development of interfacing control software which will enable all equipment and modules to communicate over one commonly specified standard;
- Collaboration on the specifications of the robotics and software to ensure compatibility between the wafer-handling platforms developed within NGC450 and other current projects;
- Definition of requirements and equipment evaluation and qualification such as contamination, energy efficiency and standardisation compliance;
- Interaction during the specification review between partners involved in the integration phase, with one partner providing clean-room space with the logistics and fluids needed for the tools while also accommodating personnel from other partners and helping them with evaluation of their tools;
- Participation in the review and assessment of specifications and the provision of expertise so that developments can be evaluated for their potential on the silicon-on-insulator (SOI) production line with provision also for double silicon substrates; and
- Participation in the atmospheric mini-environment specification and development of both alpha and beta atmospheric wafer-handling equipment.

### Sharing the risks

The ultimate objective is a comprehensive package built by European semiconductor enabling-solutions providers. This package will address 450 mm challenges by sharing the same hardware and software interfaces. The development around a common software and robotics platform will share the risks, limit redundant development and thereby limit overall R&D costs.

NGC450 will use the findings and results from the first ENIAC 450 mm project and will be a reference for the next 450 mm projects, including the follow-up project of the EEMI 450 ENIAC project. Some of the NGC450 outputs will be fed into other projects such as ENIAC EEM450PR. This proves the consistent continuum set by the EEMI450 initiative.

The results of this CATRENE project will consolidate the European semiconductor equipment industry's global leadership position. Indeed, European manufacturers address a worldwide market for process equipment, material, automation and robotics.

### Eye on the competition

Most sales achieved by European semiconductor production equipment and materials companies are outside Europe. As an example, one NGC450 partner has secured more than a 25% share of the worldwide market in 300 mm wafer sorters over the last decade. More than 90% of its turnover comes today from outside Europe. Moreover, Europe accounts for only 7% of its worldwide installed base of nearly 700 units of 300 mm equipment.

World-leading equipment supplier ranking is currently held mainly by US and Japanese companies. Equipment suppliers from these

two areas have already secured a position in this new 450 mm segment. NGC450 presents an opportunity for Europe to establish and develop its own share of this global market.

If European companies manage to achieve the 450 mm goal in good time, they will have an excellent opportunity to share in the investments which are likely to be made in South Korea and Taiwan.

### European economic advantage

As indicated, 450 mm migration raises technical and financial challenges. This CATRENE project will provide the European semiconductor materials and equipment industry with the opportunity to co-operate to optimise R&D efforts and minimise related risks. NGC450 is enabling these European companies to focus on a common target which is to reduce the time to market of European-made 450 mm enabling technologies and give interoperability advantage to European equipment suppliers.



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CATRENE (Σ! 4140), the EUREKA Cluster for Application and Technology Research in Europe on NanoElectronics, 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.

