



**Coordination Action to enable an effective
European 450 mm Equipment & Materials Network**

Enable 450 Newsletter

Issue 11

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Enable450 Newsletter

Welcome to the eleventh newsletter for the Enable450 project. Unfortunately there still isn't the degree of activity in 450mm technology occurring to make it be needed more regularly.

If you would like to supply information for publication, please contact the editor at mbryant@futurehorizons.com.

Our website is available to allow previous issues to be downloaded.

<http://www.enable450.eu/index.html>

Please distribute this document to anyone who might be interested and you may place it on your own intranet if you wish.

Overview

450mm wafer technology remains out of the main focus of the industry for now, since as soon as the 20nm technology started shipping, interest moving straight onto moving the 14nm node into production. Now we are seeing a repeat with the 10nm node and discussions have even begun on 7nm.

It thus seems that despite predictions that the cost advantages of feature shrinkage would end, smaller transistors rather than larger wafers remain the prime method for cost reduction in advanced semiconductors.

However to produce these nodes still requires more advanced processing technology and so we are definitely now seeing the research performed at G450C in Albany and on many European 450mm related research projects beginning to be used on advancing 300mm processing equipment and materials. Several of the papers presented at the recent Semicon Europa in Dresden focused on this very point and are described more fully later in this newsletters.

In previous issues of this newsletter we have highlighted the contribution Europe has made to the Notchless Wafer standard, primarily through the efforts of RECIF Technologies, and to the smaller edge exclusion zone. Both techniques increase the number of die that can be fabricated on a wafer. An interesting rumour currently circulating is that one major semiconductor manufacturer has been asking its suppliers what would be the implications of applying these two techniques to 300mm wafers so as

to weigh up the benefits against cost. Another discussion point has been on what is the largest wafer size that could actually be fitted into a 300mm FOUP and what would the costs be to modify all processing equipment in a fab to handle this new size.

Obviously both of these may be nothing more than simple 'bar talk', but if either move to production they would be interesting spin-off developments from the 450mm programmes.

SEMICON Europa 2015



The SEMICON Europa 2015 conference and exhibition took place in Dresden from October 6th to 8th 2015. Unlike in previous years there was no dedicated session on 450mm technology but the Semiconductor Technology Conference (STC) “Productivity Enhancements for future Technology Nodes” included some updates on 450mm technologies.

Some notable presentations were :

Mike Czerniak of Edwards presented “Preparing fab facilities for 450mm - Modelling and verifying energy-saving idle mode strategies for future 450mm fabs as part of the European EEM450PR project”. This covered the work of Edwards and M&W in identifying and implementing idle modes for most processing equipment so as to reduce power consumption of the fab. It emphasised that the newly updated SEMI signalling standards currently at the ballot stage are essential for optimal savings. The project also modelled and tested Idle Mode for a current 300mm fab and a hypothetical 450mm fab and similar results of around 15% to 17% energy cost savings were identified, highlighting once again that work performed on the ‘450’ projects, in this case EEM450PR, is also driving improvements in existing and new 300mm fabs.

Alain Jarre of RECIF presented “450mm module readiness and direct benefit for 300mm yield improvements” which highlighted their work on a prototype 450mm sorter, on their contribution to the new Notchless wafer standard, on their updated cleanliness targets, and on how RECIF’s unified 450/300mm roadmap has allowed this work to be directly fed into their latest 7nm capable 300mm sorter.

Mike Cooke of Oxford Instruments presented “450mm plasma etch module” which was an update of his presentation the year detailing progress on the EEM450PR project. He explained how they have found the optimal 450mm plasma etch source is both larger and different to the 300mm product. The larger wafer size has also forced the hinged chamber lid at 300mm to become a lift and rail system. The company also performed large area uniformity tests by placing fourteen 100mm test wafers inside the 450mm chamber and used these to optimise parameters. The Table Height was found to be the key parameter for uniformity. They also found that for etch rate, at 300mm the rate depends on ICP power, Bias power and pressure, flow, whilst at 450mm the etch rate depends on Coil power, Table height, Table power and pressure, flow.

NirKarasikov of SVP Nanomotion gave an update on their work in the MAGNET consortium of Metro450 WP1 addressing the wafer handling challenges of 450mm, specifically with respect to Increased throughput, Accuracy and Cleanliness. He described how a 450mm metrology stage can now weigh over 100kg and explained the challenges in the wafer accurately to within a few nanometres in the X, Y and Z dimensions as fast as possible. The presentation then highlighted some of the methods they have been researching to achieve this in each part of the wafer handling during metrology.

Finally Fouad Atrach of Jordon Valley presented “Analysis and In-Line Monitoring of Non-Visual Crystalline Defects (cNVDs) in Silicon Wafers to Identify Wafers at Risk from Breakage” detailing their work in WP3 of Metro450. Their goal is to “Define an engineering envelope of mechanical handling in anticipation of increased acceleration and deceleration , weight and momentum associated with 450mm wafers.” All the methods by which wafers can be broken during processing have been analysed and X-ray methods developed to identify when this is happening. The shape of the wafer bevel edge was identified as a key issue in reducing damage. They also identified that even small misalignments in wafer handling equipment can lead to cNVDs and that they would like to work with the designers of wafer handling equipment to reduce these occurrences.

EEMI450 General Assembly



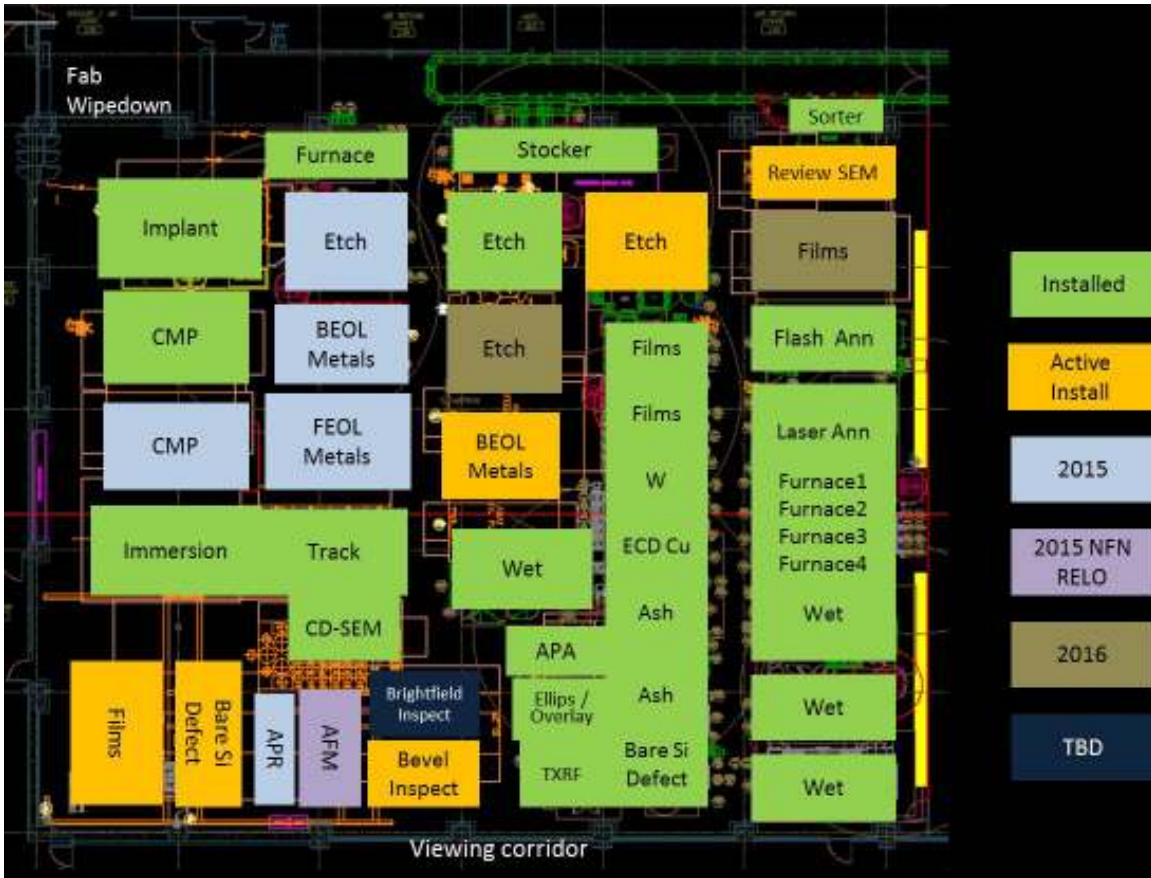
Directly after Semicon Europa on the afternoon of October 8th there was a General Assembly meeting of the EEMI450 initiative to replace the one planned for last April which had to be cancelled.

G450C Update

After introductions were made, the meeting began with a presentation from Paul Farrar of G450C detailing the latest updates on work at Albany, particularly on 450mm productivity. He said that the G450C has secured funding until at least the end of 2017 and work will focus on improving both tool performance and productivity. All five member companies (Intel, TSMC, GLOBALFOUNDRIES, IBM and Samsung) are still active, along with New York State partnering with SUNY Polytechnic Institute.

After presenting the usual benefits of 450mm, he mentioned that there is increased emphasis on the Green Fab that larger wafers can enable by reducing the usage of materials, water and electricity.

He then gave the latest progress on the G450C work. Key amongst these is they intend to have full 14nm and 10nm capability in place by 2016. He described how there are now over fifty different toolsets in place in their cleanroom with planned installs for the rest during the next year as shown in the equipment layout diagram he provided below.



Progress on the current installation of a Nikon 450mm immersion litho machine with Gigaphoton laser and Screen developing track was given, including mention of the large amount of effort required to install a modern litho.



Paul also mentioned how this litho machine brings 96% process function coverage at G450C, although he didn't say what the missing 4% was.

Meanwhile the first 132 notchless wafers have been successfully patterned in Japan.

Finally he gave a list of Key Messages on 450mm readiness :

- Process Capability demonstrated on 98% 14nm process steps
- Productivity: 80% of process tools can achieve 300mm equivalent or better (WPH)
- Performance: Process tools at or near 300mm process targets
- Suppliers can deliver HVM tools in 18-24 months after signals
- Potential die cost savings of >30% achievable
- All G450C member companies have stated they still want to keep a viable option for 450mm, and consider 450mm a strategic opportunity.

The full presentation is available online at :

<http://www.g450c.org/SEMICONEuropafinalversion.pdf>

Other Business

The EEMI450 meeting then moved onto the main proposal at this meeting which was to discuss how does the initiative met current industry needs, should it stop, or refocus. This was in response to a lot of recent discussions debating whether the delay until 'at least 2020' by Intel will in fact turn into 450mm never being rolled out.

After some quite impassioned speeches outlining all views both positive and negative, the consensus of the majority was to adopt a suggestion made by Georg Kelm, now retired but one of the great supporters of the 450mm projects during his time at the European Commission. This was to rename the initiative as EEMI4PRO where 'PRO' stands for Productivity. This still of course covers 450mm as if it is rolled out this still represents one of the best ways to improve productivity. However the new name covers more immediate developments by European E&M companies as well and so avoids the likelihood of the group becoming irrelevant.

It should be emphasised that this group is not intended to compete with any work SEMI Europe perform but rather to try to continue and expand the constructive contacts EEMI450 has built up with other groups such as G450C and Metro450. Whilst the larger companies such as ASML and Imec will always be part of most semiconductor company's plans, these discussions have kept the smaller European E&M companies 'on

the radar' and informed them of all the latest advances, and indeed have provided a conduit for contributions from Europe during the regular meetings between EEMI450 and G450C.

The EEMI450 initiative has also been significant in that proposals by its members for funded European projects have not needed the support of the European IDMs, and the European E&M industry is now seen as a supplier to the whole world, something which wasn't always the case a decade ago especially for the SMEs.

Bas van Nooten of SemiConsulting was then 'persuaded' to remain as the leader of the new group for now, but he did suggest it might be better if someone more active in the European E&M community took over this role in due course. However he still produced this suggested new logo below soon after the meeting.



Presentations

Before wrapping up the meeting a few more presentations were made, these being :

“New European Eureka Cluster program PENTA” by Alain Jarre of RECIF outlined the new PENTA programme which replaces CATRENE. More details on this will be given at the upcoming European Nanoelectronics Forum in Berlin in December.

“IPCEI - the ‘Juncker plan’” by Mike Bryant of Future Horizons outlined the efforts that were made by some notable industry professionals over the past year to establish a new 450mm capable memory fab in Europe and the difficulties in raising suitable finance nowadays.

Finally Udo Nothelfer of the Silicon Saxony Working group “SETUP 4 Fifty” explained their setup and latest progress.

Enable450 and Bridge450

These two Co-ordination & Support Actions are funded by the European Commission. With the announced delays in the 450mm rollouts by the key companies concerned, the work of these projects becomes a little premature.

At a joint project meeting in Dresden, it was thus proposed, subject to the agreement of the European Commission Project Officer, to merge the two projects into a single project. The new project would be focussed on :

- Information gathering from G450C activities and Metro450
- Second phase of the Asian visits of Bridge450 to this time focus on promoting European E&M, especially SMEs, in China
- Produce a report on the implications of the 450mm delay and what is needed to ensure the research performed to date is kept ready and updated for use when a 450mm rollout does occur
- Generate a compilation of both the benefits and downsides for the EEMI450 partners of their participation in the European 450mm activities
- Including more general equipment topics like production enhancement, green manufacturing
- Continue publishing this newsletter on an as-needed basis

European Nanoelectronics Forum 2015

This year's European Nanoelectronics Forum will be held on December 1st and 2nd in Berlin. Please see their website

<http://www.nanoelectronicsforum.org/>

for details on how to attend.

It is expected that the latest results from all the European Commission funded '450' projects will be displayed in the poster display, and experts from each project should be on hand to answer any questions you may have.

450 Millimeters of News

450mm Central

The SEMI 450mm website continues to be the best resource for papers on 450mm issues.

Recent updates include :

- How About 310mm Wafers? Or 320mm? Or Even 350mm? (ElecWkly, Sept 25)
- White Paper: Semiconductor Industry 2015-2025 (section 2) (SEMI/IBS, Aug 4)
- F450C Panel Updates Progress at SEMICON West 2015 (F450C, July 23)
- SEMICON Day 3: Leti, Intel Keynote, 450mm (Pic!) and Innovation Keynote (SemiWiki, July 15)

All the links are on this page :

<http://www.semi.org/Issues/450mm>

450mm In The Press

Other mentions of 450mm in the press include :

“Markets need strategic vision and investment” by Adam Fletcher suggesting that Europe needs to invest in a 450mm fab or regret it in a decade’s time.

<http://www.electronicweekly.com/blogs/distribution-world/comment/markets-need-strategic-vision-investment-says-adam-fletcher-2015-09/>

“IC Insights’ McClean Report Forecast Revisions” reports that Bill McLean commented “Five years ago I was 95% sure it would happen in about five years, now its 50/50 whether it happens at all.”

<http://electroiq.com/insights-from-leading-edge/2015/10/iftle-257-ic-insights-mcclean-report-forecast-revisions/>

http://www.eetimes.com/document.asp?doc_id=1328079 details similar information.

“The Future of Semiconductor: Reaching 450mm Wafers” analyses the advantages of using 450mm for logic or memory.

<http://www.thequartzcorp.com/en/blog/2015/03/17/the-future-of-semiconductor-reaching-450mm-wafers/125>

“Companies Maximize 300mm, 200mm Wafers; Slow Progress on 450mm” gives some useful information on the expansion of 300mm wafer fab capacity.

<http://www.design-reuse.com/news/38229/global-wafer-capacity-2015-2019-report.html>

450mm Standards Update

Conversely there have been no updates by SEMI on 450mm standards, but all are listed on their standards page at

<http://www.semi.org/en/node/41211>

10/100/20

The 10/100/20 initiative was announced by Commissionaire Neelie Kroes in 2013 and aims to achieve 20% of world semiconductor production within Europe by 2020.

Since then the new European Commission President, Jean-Claude Juncker of Luxembourg, has instigated the new European Fund for Strategic Investments (EFSI) under which Important Projects of Common European Interest (IPCEI) will operate in many key industries, amongst which is semiconductors.

The fund size is €21 billion but it is hoped this will release up to €315 billion in other investments. The money was redirected from the Horizon2020 research funding budget, raising the ire of University leaders across Europe, many of whom had become rather over-dependent on European funding rather than from their own country governments.

In the semiconductor field a number of IPCEI projects are being considered. One focused on non-volatile memory, including an option for building a fab capable of being upgraded from 300mm to 450mm when equipment became available. However support for this within Europe was somewhat muted at best and the team involved are now seeking funding from China.

Editorial

Any views expressed here are those of the editor and not necessarily of other European 450mm project members.

As can be seen from this newsletter, the area of 450mm wafer technology has become a case of 'Hurry up and Wait'. The distinct possibility that the new wafer size may never be rolled out has to be considered, but conversely if one of the key companies suddenly decides to press the Go button then European E&M companies need to be ready.

What has become obvious is that unlike the 200mm to 300mm transition where there was a very distinct technology break with little ripple down into the smaller wafer size, this time there is a significant transfer of 450mm R&D into upgrading 300mm equipment and materials. An important issue now is to work out how to ensure the knowledge of producing and processing 450mm wafers is maintained in one form or another so that a future rollout is still possible. However equally it has to be accepted that outside of CNSE there will be little funding made available for achieving this.

Possibly the most frustrating thing about the delay is that whereas the DRAM market is likely to actually need a little less fab capacity in future as die size shrinks are exceeding market growth, and the logic market growth is also dropping off, non-volatile memory represents one of the major semiconductor growth areas for the next five years after MEMS and Sensors. Existing fabs will not be adequate to meet demand and fortuitously 3D Flash technology has the best cost advantages of any product on 450mm wafers. However it is possible the new Intel 3D XPoint technology may not possess these same cost advantages on 450mm wafers and could be contributing to why Intel are biding their time on the new wafer size.

The expectation has to be that more memory production will move to China over the coming years and it may be that they are willing to take the risk on funding the first 450mm fab in an attempt to dominate the market. Only time will tell on this.