SCREEN Semiconductor Solutions Co., Ltd.

Accelerated innovation through strategic collaboration: a view from an equipment supplier

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CTO

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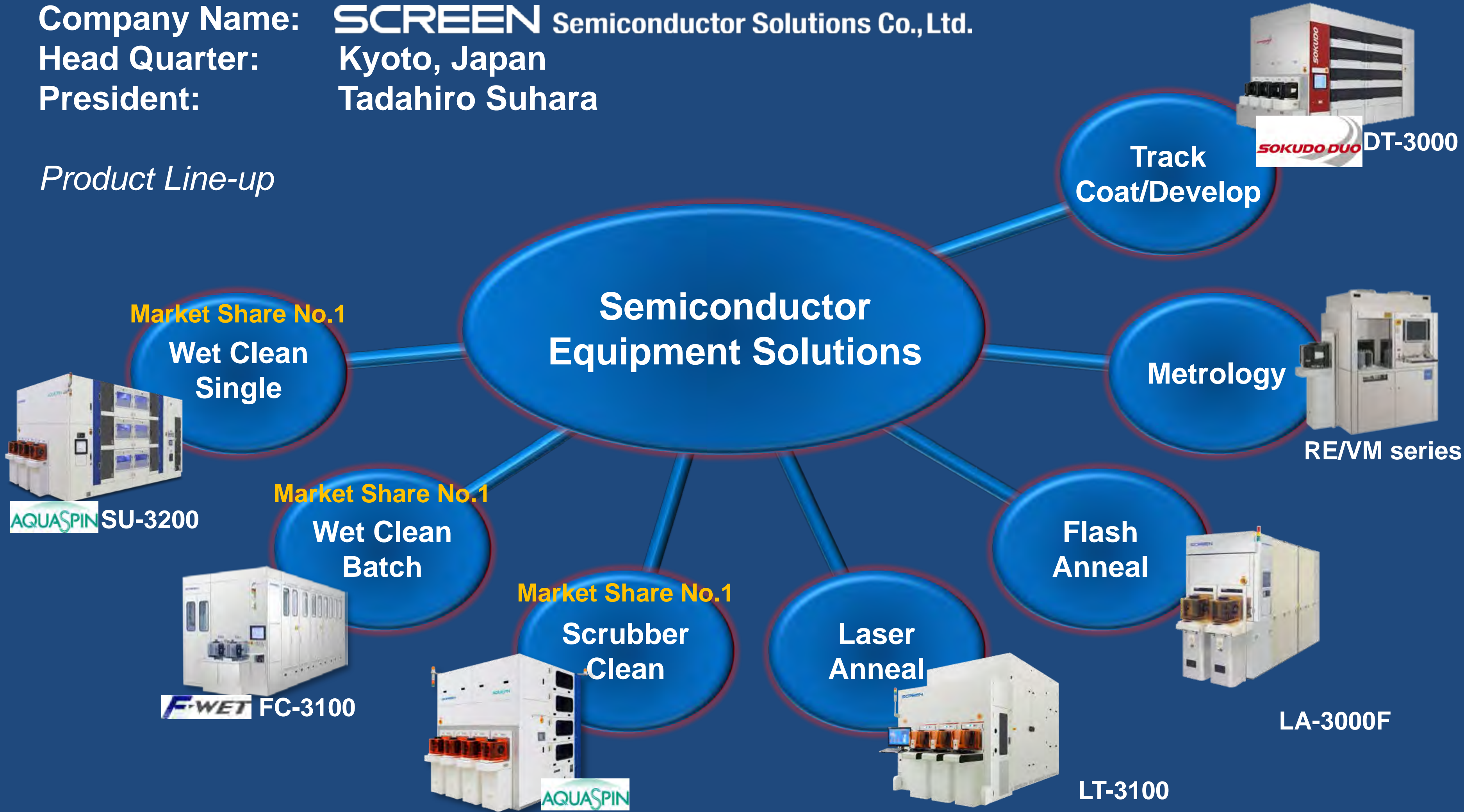
SCREEN

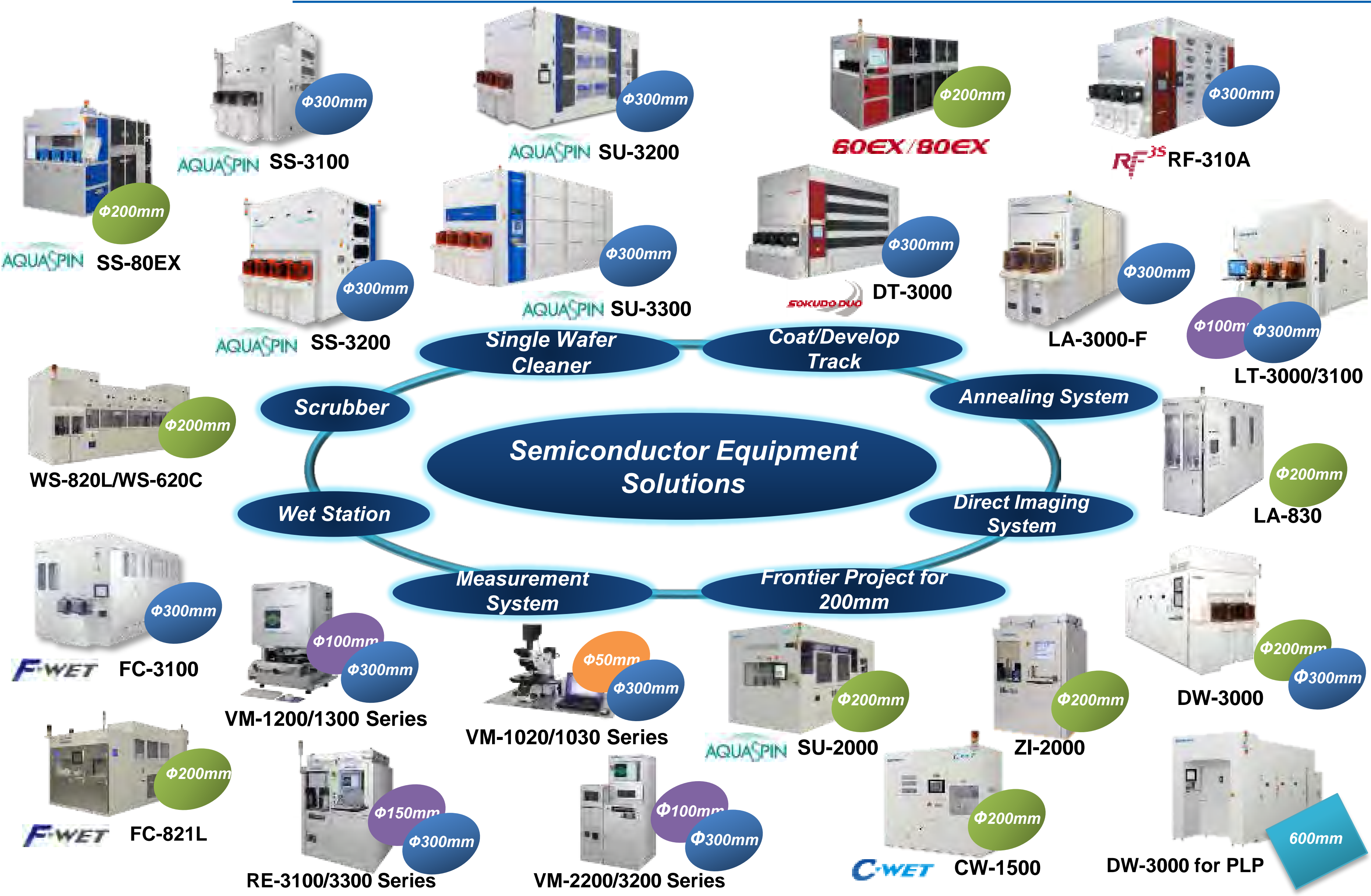
AGENDA

1. Company outline and Product Line-up
2. LETI collaboration → A long History
3. Wet Clean & Litho. Track highlights
4. Focus on Laser anneal collaboration
5. Conclusion

Providing leading-edge technology and solutions



Product Line-up



Office and Plants Locations

Process Technology Center
(Hikone Plant)

Headquarter

Fab. FC-1･FC-2
(Hikone Plant)

Taga Plant

Global Training Center
(Yasu Plant)

WHITE CANVAS RAKUSAI
(Rakusai Site)

LETI Partnerships in Wet, Laser Anneal & Litho Tracks

PRESS RELEASE

SCREEN SEMICONDUCTOR SOLUTIONS AND LETI EXPAND COLLABORATION TO COVER LASER ANNEAL TECHNOLOGY

KYOTO, Japan and GRENOBLE, France – Dec. 1st, 2016 – "SCREEN Semiconductor Solutions Co., Ltd. (SCREEN) and Leti, a CEA Tech institute, today announced they have stepped up their collaboration with the installation at Leti's site of a nanosecond-scale UV laser anneal LT-3100 system to be delivered by Laser Systems and Solutions of Europe (LASSE), SCREEN's subsidiary based in France"

"The introduction of SCREEN's nanosecond-scale UV laser anneal tool in Leti's leading-edge, pre-industrial equipment infrastructure will open new innovation opportunities for current and future technology being developed on site," said Leti CEO Marie Semeria. "With SOI, CoolCube™ and nanowire technologies development, we are facing increased challenges in developing new material property and ultra-thin-film modification with minimal thermal impact. Leveraging the LT-3100 system will enable solutions for technology breakthroughs that will eventually lead to the development of practical demonstrators for industry."

"Following a long history of successful joint developments with Leti, we are very excited by the opportunity to bring our laser technology to Leti's ecosystem to support 'More than Moore', IoT and future innovation technology requirements," said Tadahiro Suhara, president of SCREEN Semiconductor Solutions. "In addition to the collaboration activities, we will use Leti's state-of-the-art infrastructure to operate our LASSE European demo lab, giving our customers unprecedented demonstration infrastructure capability. We expect to showcase the innovation value that our nanosecond-scale UV laser-equipment technology and resources bring to advance semiconductor process development in multiple fields of research and development as supported by Leti."

The Laser tool is expected to be fully operational in the first half of 2017 and will support multiple wafer size requirements to meet the different needs of Leti's laboratories.

PRESS RELEASE

SOKUDO Joins CEA-Leti IMAGINE Program to Develop Multiple E-Beam Lithography Process

KYOTO, Japan and GRENOBLE, France – Sept. 16, 2010 – SOKUDO Co., Ltd., the lithography coat/develop track process equipment joint venture company, and CEA-Leti today announced that SOKUDO will join the new industry/research multi-partner program IMAGINE that is developing maskless lithography for IC manufacturing.

The three-year project is led by CEA-Leti, the leading French semiconductor research institute, and also includes semiconductor manufacturers TSMC and STMicroelectronics. It is evaluating a maskless lithography infrastructure and the use of MAPPER Lithography tools for high throughput. The multiple e-beam-lithography program covers a global approach to the technology, including tool assessment, patterning and process integration, data handling, prototyping and cost analysis.

"E-beam has the potential to be a viable technology for many sub-22nm lithography process layers in logic/foundry semiconductor manufacturing," said Tadahiro Suhara, SOKUDO president and CEO. "SOKUDO is taking a comprehensive approach to being prepared for coat/develop track process readiness in multiple sub-22nm lithography technologies, including immersion ArF lithography extensions, EUV and e-beam lithography. The CEA-Leti IMAGINE collaboration brings together a focused effort to enable production-worthy e-beam lithography, including multiple resist manufacturers key to sub-22nm process development."

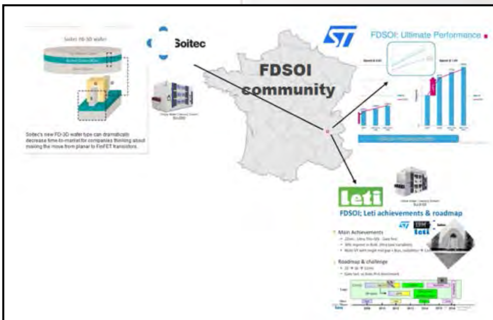
"We have been working with SOKUDO's RF3 coat-and-develop track system for many years and the IMAGINE program will benefit from the strong knowledge and support of SOKUDO in developing the necessary processes to support maskless technology," said Serge Tedesco, CEA-Leti program manager. "The experience of CEA-Leti in e-beam technology combined with SOKUDO's coat-and-develop track expertise will help secure the necessary process infrastructure for multi e-beam lithography."

MAPPER Lithography B.V., based in Delft, The Netherlands, makes maskless-lithography machines for the semiconductor industry. It is supporting the IMAGINE project with its massively parallel electron-beam platforms.

LETI-SCREEN wet technology engagement

- 2012: SCREEN engagement via JDP's in FDSOI community. (STMicroelectronics, SOITEC, LETI)
- 2012: Installation of first WET Single Wafer Cleaner SU-3100 for FEOL applications.
- 2014: Installation of second WET Single Wafer Cleaner SU-3100 for BEOL applications.
- 2015: SCREEN joined European program WAYTOGOFAST.

Single Wafer Cleaner SU-3100



Single Wafer Cleaner SU-3100

2012 2014 2015

Why Lithography Alternatives Are Essential

Article in Solid State Technology from Laurent Pain, Raluca Tiron, Ludovic Lattard, Stefan Landis and Cyrille Laviron

KEY PROJECTS:

1. Leti IDEAL JDA to achieve DSA POR and process yield (CH Via)

2. Leti IMAGINE JDA to achieve E-Beam POR enabling new market

3. Improve Defect /CDU /LWR with new technologies

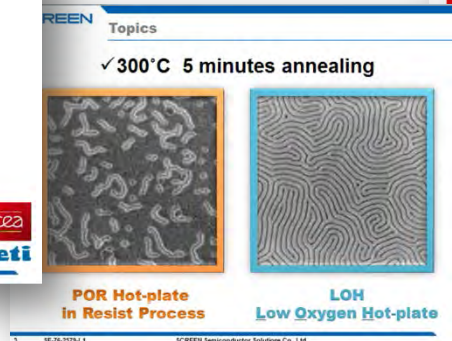
4. New process development with chemical venders

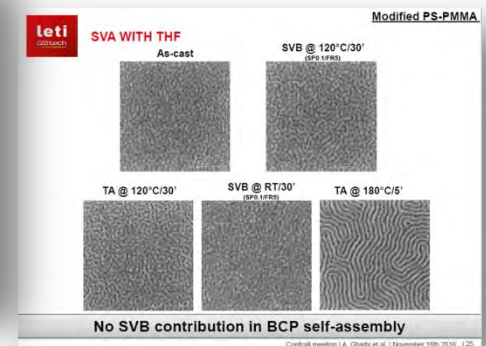
Conference publication with Leti

♦ SPIE Advanced Lithography 2013~2018

- The potential of block copolymer's directed self-assembly for contact hole shrink and contact multiplication (2013)
- 300mm pilot line DSA contact hole process stability (2014)
- Handling, clamping and alignment evaluation for Multi-beam technology on Matrix1.1 platform (2014)
- Investigation of coat-develop track system for placement error of contact hole shrink process (2016)
- DSA process window extension via controlled atmospheric conditions through accurate defectivity and roughness measurements (2017)
- A track process for solvent annealing of high-χ BCPs (2017)
- DSA Process Window Expansion by Oxygen Concentration (2018)

♦ International Symposium on DSA 2015, 2016, 2017





TODAY NEAR FUTURE 2018

E-Beam Exposure niche market development for rapid prototype IC

FX-1200 E-Beam Exposure Tool

track in-line integration

Immersion ArF Lithography NXT:1970Ci Lithocell @ CEA-LETI

track in-line integration

New 2014 SCREEN Group Company: Laser anneal

LASSE

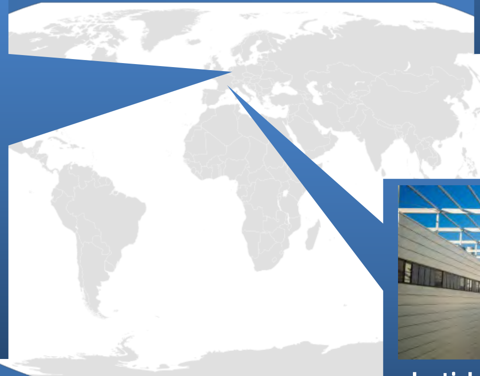
Laser Systems and Solutions of Europe SAS

Development and production of Laser Thermal Anneal

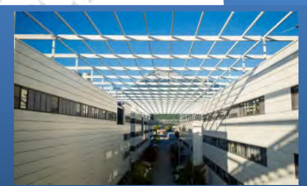
Establishment : June, 2014
President : Tadahiro Suhara

14-38 Rue Alexandre,
Bldg D F-92230 Gennevilliers,
France
Tel : +33-1-41-11-2720

LASSE HQ Factory



SCREEN Process Technology Center


Leti-LASSE Process Development lab

Main product: Laser Annealer

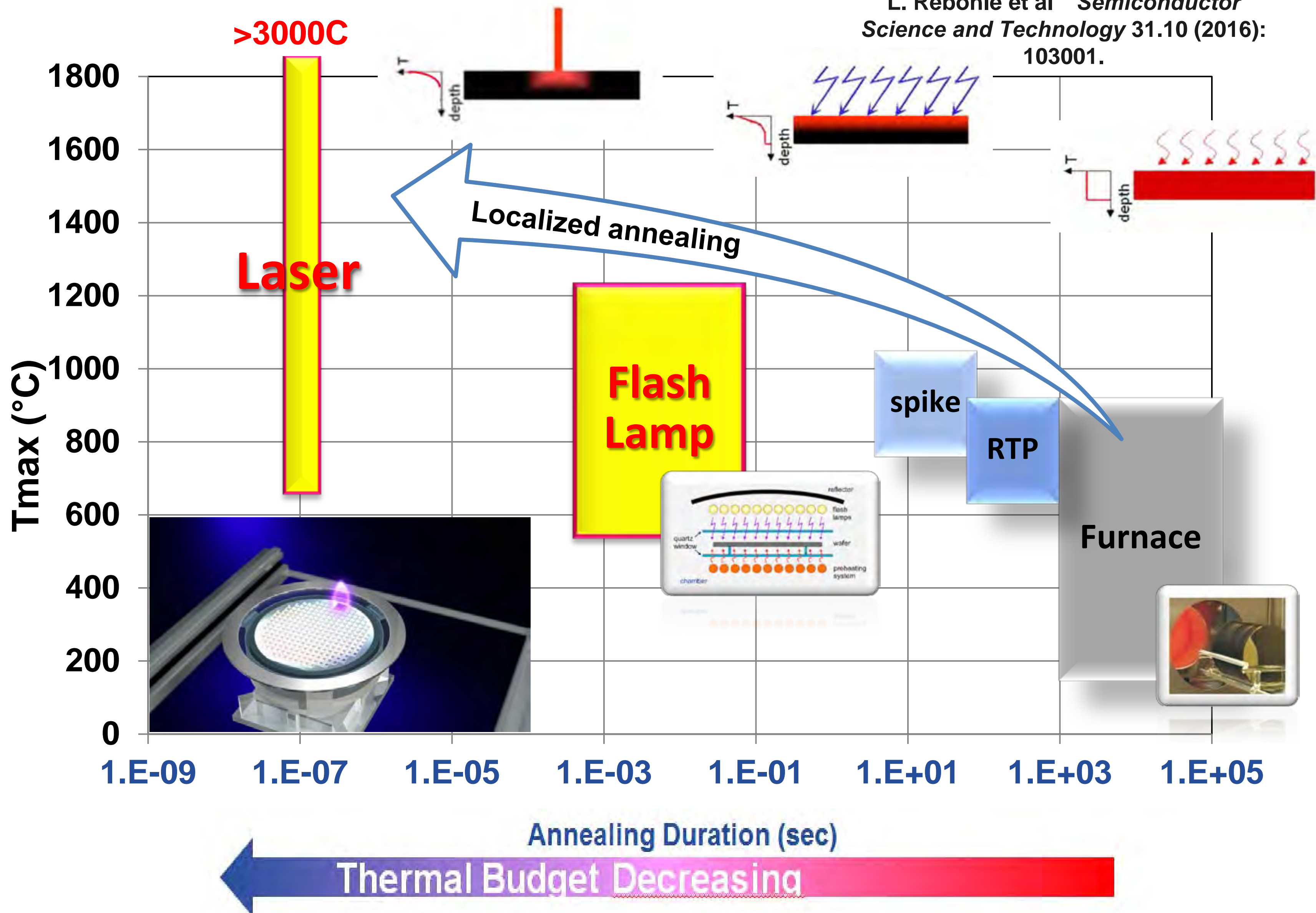
LT-3000/3100

- **Ultra-low Thermal Budget**
  Achieving the highest possible temperature gradient in sub-micro seconds, LT tools are able to anneal fragile substrates without damaging critical device structures.
- **Full Device Exposure**
  Annealing one die, a group of dies or only the desired region in a single shot, the LT makes it all possible by shaping the beam size to meet process and device requirements without stitching.
- **Dopant Activation Control**
  Obtaining unprecedented high line and parametric yield levels are only possible with the LT annealing process. By melt-annealing, the dopants are superactivated and the low resistance layer is defect free.

LT-3100 UV ns laser annealing

- The only production proven Melt Laser Anneal Technology
- High Energy UV pulsed (160 ns) laser for shallow anneal
- Step & repeat anneal process up to full field size (no stitching)
- High productivity and modular platform

Thermal Annealing Technology Portfolio



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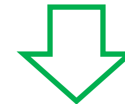
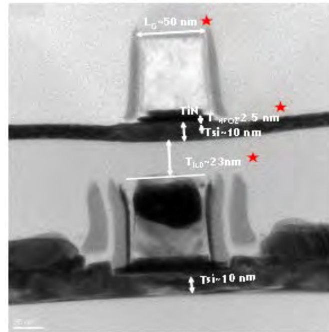
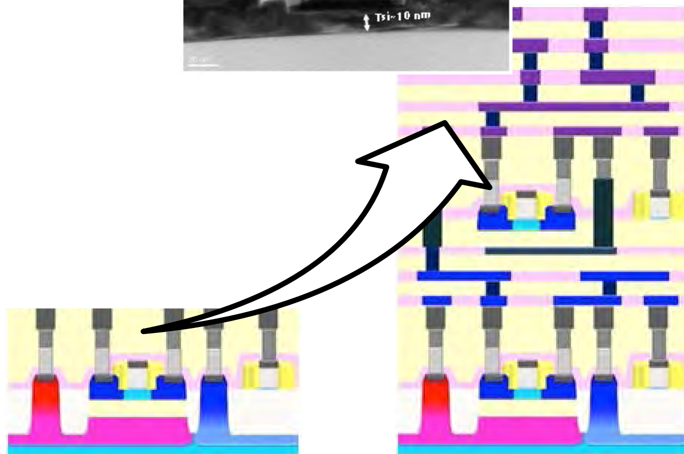
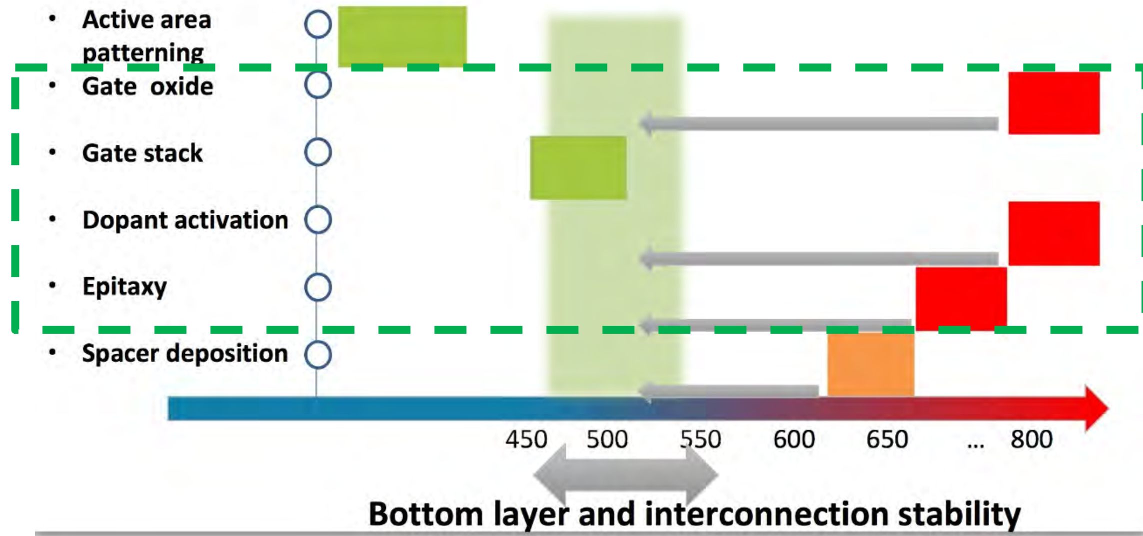
CoolCube® : 3D integration challenges

Candidate application for laser annealing









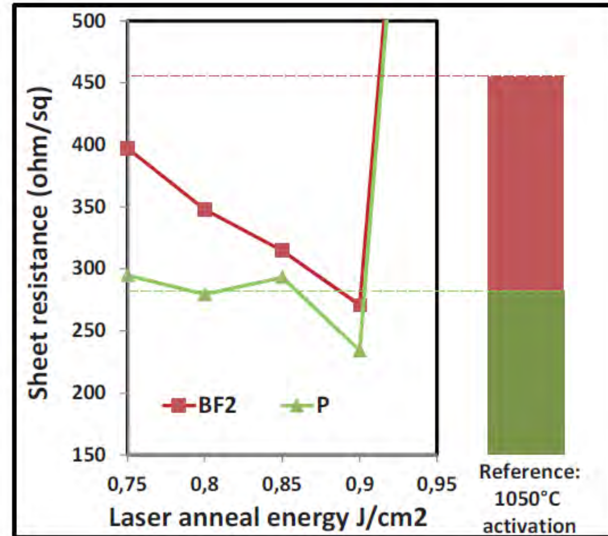
From Ieti CoolCube Program

Need for process solution capable of surface localized annealing without affecting buried structure

LT-3100 for Monolithic 3D integration

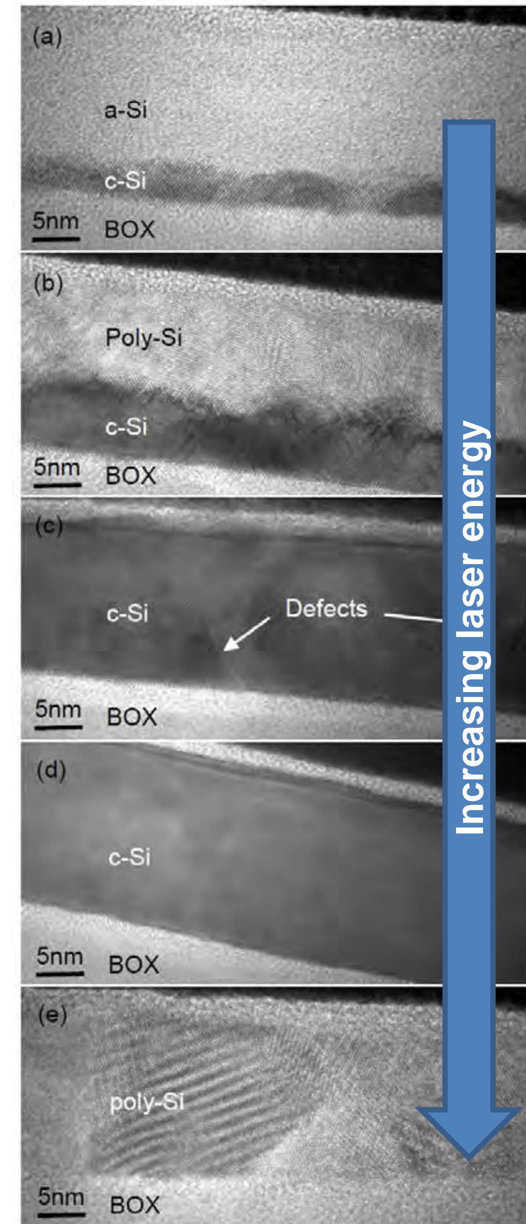
P. Batude et al, VLSI 2011

- **Ultra localized annealing on top layer:**
  - Crystallization
  - Activation
  - Stress engineering



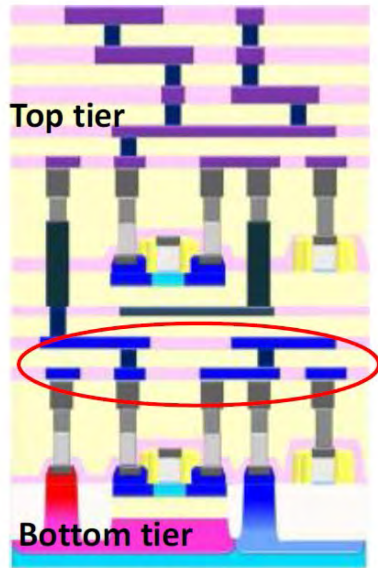
S. Kerdilès et al. in proceeding IWJT 2016

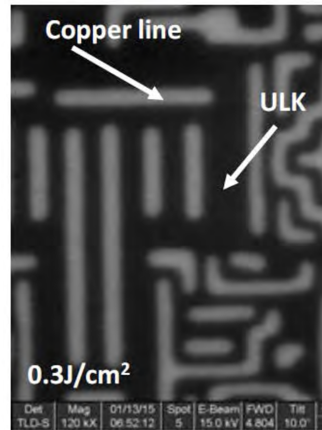
Arsenic junction

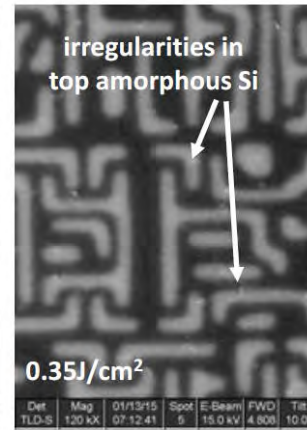


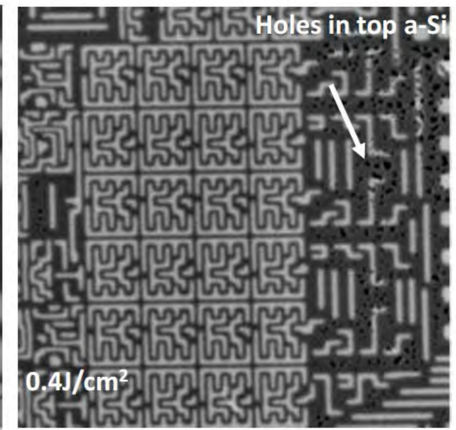
CoolCube® Interconnect robustness to LT-3100

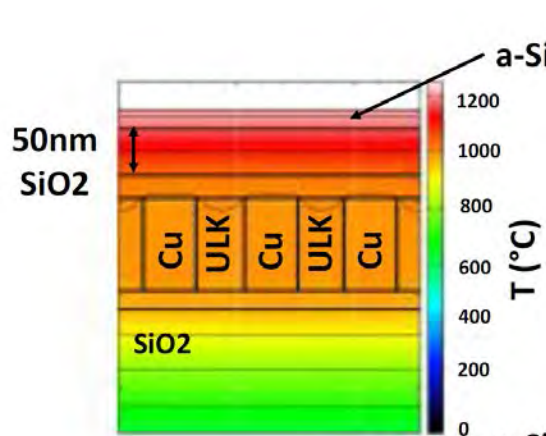
Interconnect not degraded at high temperature in nanosecond timescale

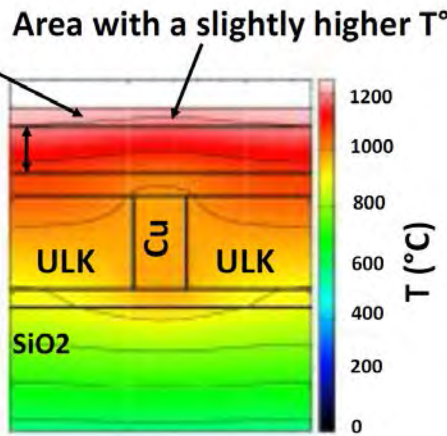


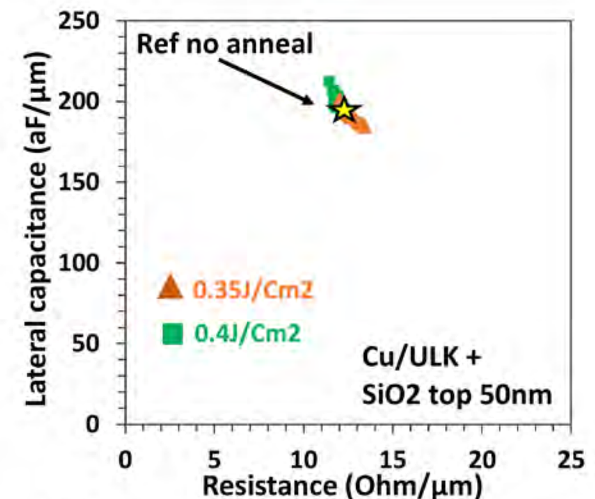






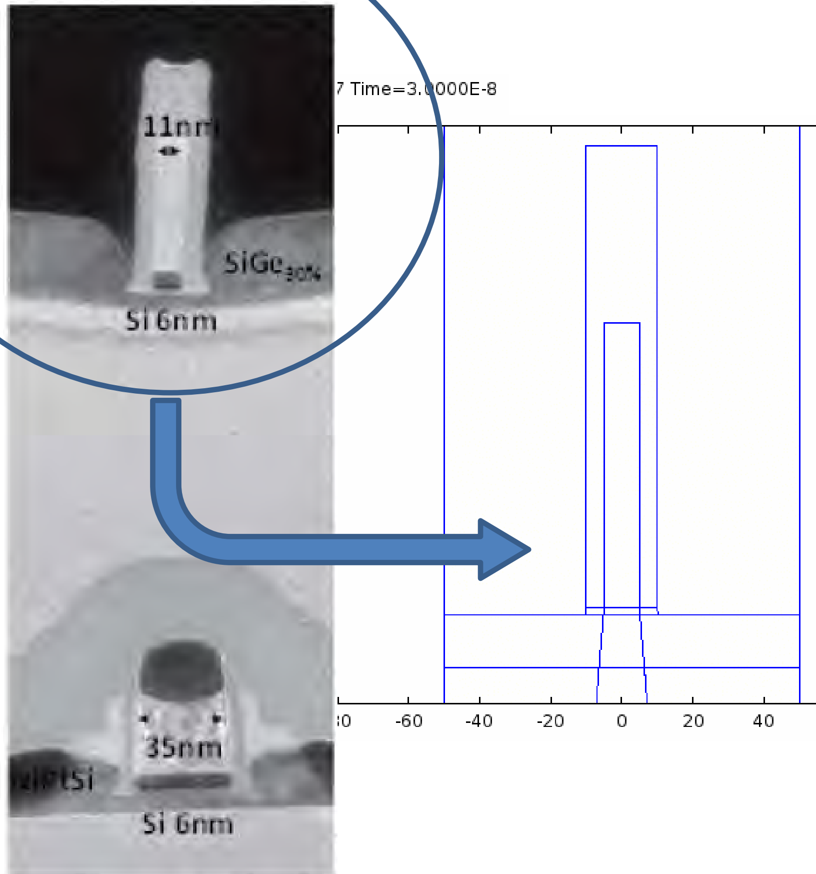






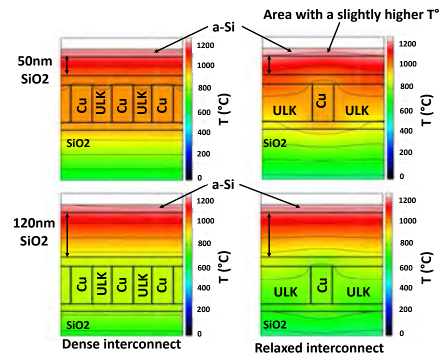
C. Fenouillet S3S 2015 (Leti)

Laser integration supported by LASSE Innovation Booster



Simulating thermal, phases, diffusion dynamics during laser annealing

- ✓ Fully-owned Standalone software
- ✓ Native 3D
- ✓ Collaborating and developing with top academic experts
- ✓ Customer oriented
- ✓ Optimized for LT technology



Conclusion

Accelerated Innovation through Strategic Collaboration

1. **This is not a nice to have value proposition**

2. **Build overtime through deep technology exchange**

3. **Mutually beneficial ⇔ Need to offer Win-Win**

4. **Benefits our customers with innovation acceleration**

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Fit your needs, Fit your future

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