R&D partnerships by adixen Vacuum Products

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Agenda

- Adixen Vacuum Products and Pfeiffer Vacuum Group
- Our involvement in collaborative R&D projects
- Benefits from collaborative R&D projects
adixen Vacuum Products at a glance

- Expert in vacuum technology, leak detection & contamination management
- Sixty years of experience developing innovative products for the semiconductor, instrumentation, R&D and industrial markets
- 560 employees in Annecy, France
- Part of Pfeiffer Vacuum group since 2011
  - For over 120 years has set the standards in vacuum technology
  - Leading supplier for vacuum solutions for evacuation, measuring and analyzing vacuum
adixen Vacuum Products

Vacuum components

Instruments

Contamination Management Solutions
Pfeiffer locations and employees worldwide

- **The Americas**: 147
- **Europe and Africa**: 1,500
- **Asia-Pacific**: 590

Employees total: **2,237**
Pfeiffer vacuum production worldwide

- Asslar/Germany
- Cluj/Romania
- Annecy/France
- Asan/Korea
adixen involvement in collaborative R&D projects
Our involvement in collaborative R&D projects

- Which projects?
  - adixen Vacuum Products participates in numerous national and European clusters/projects
    - Europeans Clusters: CATRENE, Eniac / Aeneas, FP7
    - French national/Regional competitiveness clusters: Minalogic, Arve Industries and Tenerrdis

- Partnership
  - with highly qualified laboratories & many recognized industrial partners

- Domains of interests
  - Partners in semiconductor, PV & LEDs applications Projects
Example 1: EXEPT /

- EXtreme UV lithography Entry Point Technology development within the framework of the CATRENE Program.

- Goal: to develop technologies, tool & infrastructures components as required for high volume EUV lithography for 22nm node in 2012.

- Partners:
  - ASML
  - Media Lario Technologies
  - Fraunhofer IISB
  - XTREME technologies
  - FOM Foundation for Fundamental Research on Matter
  - SAFRAN Sagem
  - ZEISS
  - imec
  - DMS
  - SUSS MicroTec
  - HAMATECH APE
  - Advanced Mask Technology Center
  - CERN
  - USM
  - AIX-TEC
  - Aneas
EUV lithography constraints: 13.5 nm wavelength

- 13.5 nm Wavelength: optical path has to be in vacuum, no refractive optics but mirrors
- In the EUV tool, outgasing (H2O, hydrocarbons) can damage optics. EUV mask outgasing has to be minimized to avoid any reflectivity loss.
EUV lithography constraints: 13.5 nm wavelength

- EUV mask is a mirror and is pellicle less.
  - to be cleaned regularly to avoid reflectivity loss of MoSi multilayers due to contamination
  - Mask cleaning tool must be integrated in the fab
- EUV mask (multilayer) is very sensitive and heating temperature lower than 70°C, temperature uniformity better than +/- 5°C;
  - hot plate cannot be used for drying
Collaboration inside Exept project

**EUV photomask domains:**
- Ultra cleanliness needed (water residues, carbons...)
- Fragile photomask reflective layer: no high temperature, hot plate cannot be used
- No vacuum in current processes photomask cleaning process

**Silicon wafer domains**
- Vacuum process demonstrated to reduce AMC and to improve yield

Combine both expertises with vacuum process in photomask environment
- For EUV masks dehydration
- With constraints of cleanliness environment

Adixen dehydration tool integrated in HamaTech-Suss Mask Track Pro
Example 2: SEAL: Semiconductor Equipment Assessment Leveraging Innovation

- The European project SEAL (Semiconductor Equipment Assessment Leveraging Innovation) was successfully launched to promote European industry of the semiconductor, in a global market.

- Partners:
Advanced vacuum wafer drying for thermal laser separation dicing

- Thermal laser separation process for wafer dicing
  - Water residues/droplets have to be dried away from the dice and frame
- Process time constraints:
  - today drying done at atmospheric pressure
Advanced vacuum wafer drying for thermal laser separation dicing

- Vacuum purge demonstrated to reduce AMC on wafer substrates (fluor..)

Vacuum Purge process

- Step 1: Vaporization of water droplets
- Step 2: Vapor evacuation
Advanced vacuum wafer drying for thermal laser separation dicing

- Process validation in laboratory and fab conditions
  - Efficient and quick process

![Graph showing drying time under different conditions]

Process time

Vacuum purge
Advanced vacuum wafer drying for thermal laser separation dicing

Thermal laser separation process for wafer dicing
Water residues as side effects/time constraints

Vacuum purge demonstrated to reduce AMC on wafer substrates (fluor..)

Advanced vacuum wafer drying for thermal laser separation dicing: efficient and quick process

Fraunhofer IISB
JENOPTIK JENA
Benefits from collaborative R&D projects
A fruitful partnership for a dynamical and enhanced R&D

Strategic partnership

Innovation

Funding

Business & employment
1/ Innovation

- Access to complementary knowledge / technologies:
  - Materials, microelectronic processes, plasma sciences..
  - High level laboratories

- Excellence Network
  - Training, access to experts
  - Wide scientific network: ITN “SPAM” project: contamination in Lithography area

- Opportunities for new applications
  - Example: (EUV) lithography, PV, LEDs, pharmaceutical..
2/ Strategic partnership

- Collaboration with End Users
  - Access to customer specifications: concept adapted to customer needs
  - Win/win partnership to test/qualify/demonstrate our developments:
    - Access to platform/access to data/access to latest innovation/access to fab
    - Information on constraints/specifications of customers of our customers!
- Collaboration with Equipment manufacturers
  - New potential business opportunities
- Easier R&D collaboration inside whole project consortium
  - IP management thanks to administrative organization for the project including consortium agreement & confidential agreements
- Communication
  - Support innovative leadership and image
- Networking
3/ Funding

- Reduce risks for advanced R&D
  - Financial support:
    - To share technological challenges and dev. with partners

- Support R&D stability
  - By reducing influence of market cycles

- Allows acceleration of product development
Conclusion

- Collaborative projects are full benefit for the development of innovation
- Further to funding, they offer different opportunities from strategic partnership to network building
- Allow the development of innovative products adapted to customer needs
- Can give access to new domain of interest and new markets
Acknowledgment

- To all European and national clusters & authorities
Thank you for your attention

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