

# ENIAC

(European Nanoelectronics Initiative Advisory Council )



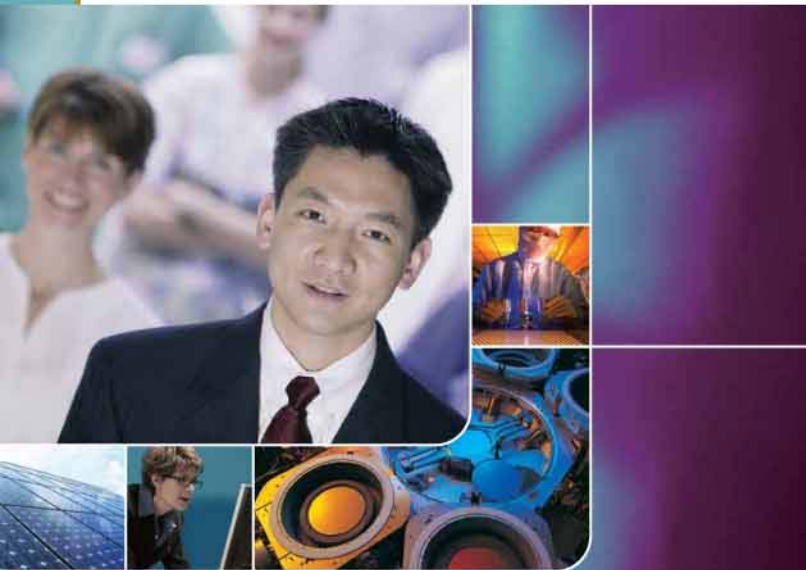
## ENIAC Update



# Update Overview

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- **Part 1:** ENIAC/AENEAS Background
- **Part 2:** SP8 Target Activities Proposals:
  - Lithography
  - Assembly for SiP (System in Package)
  - Manufacturing Science



# Part1: ENIAC/AENEAS Background



# ENIAC/AENEAS

## *Some Background*

- European R&D and innovation efforts should be better structured, optimised and integrated into a larger process involving all actors crucial to achieving a successful outcome in a given domain.
- This is particularly important for the nanoelectronics sector which has to face **extremely rapid technological development and strong global competition.**
- European nanoelectronics representatives called for the establishment of a **European Nanoelectronics Initiative Advisory Council (known as ENIAC)**

# ENIAC/AENEAS

## *More Background and JTI*

- ENIAC's main goal is to reflect on and contribute to the realisation of the future research and innovation priorities necessary to support the further development of a truly competitive nanoelectronics industry in Europe. It will do so by establishing and implementing a **Strategic Research Agenda (SRA)** for the next decades for nanoelectronics stakeholders.
- JTI?
  - A Joint Technology Initiative is a public-private partnership using the 'Joint Undertaking' model. The European Commission has identified JTIs as a new strategy of implementing the 7th Framework Programme (FP7) to support, in a limited number of cases, large scale initiatives that could not be implemented efficiently, using the other R&D funding mechanisms.
  - A JTI focuses on one specific industrial area, has a well defined objective, addresses a market failure and is funded by a combination of private and public investments.

# ENIAC/AENEAS

## *How will the ENIAC JTI work?*

- The founding members are a non-profit Industrial Association called AENEAS (set up for this purpose), Member States and the European Commission. The participation of private entities (industry, research organisations) in the Joint Undertaking will take place through membership to the Industrial Association open to all actors in this field. Any Member State or Associated State will be able to participate.
- The bodies of the Joint Undertaking shall be the Governing Board, the Industry and Research Committee, the Public Authorities Board and the Executive Director
- ENIAC being industry-led, at least 50% of their budgets are expected to come from industry, €1. billion from participating Member States, and €450 million coming from the Commission.

# ENIAC/AENEAS

## *The JU research strategy: R&D Sub-Programmes*

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SP1 - Health and Wellness

SP2 - Transport and Mobility

SP3 - Security and Safety

SP4 - Energy and Environment

SP5 - Communication

SP6 - Infotainment

SP7 - Design Methods and Tools

**SP8 – Manufacturing (Equipment & Materials)**



## Part2: SP8 Target Activities Proposals



# SP8 Workshop (22<sup>nd</sup> April) Agenda

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AENEAS Workshop on Equipment, Materials and Manufacturing:

- Introduction
  
- SP8 Target Activities
  - Lithography
  - Assembly for SiP (System in Package)
  - Manufacturing Science
  
- Subgroups – proposals elaboration
  
- Proposals Presentation
  
- Consolidation

# Lithography

- Numonyx Proposal: Lithography beyond 32nm (I):
- Objective
  - To develop and integrate the overall infrastructure required to reach patterning resolutions required by 32nm and 22nm technology nodes through the **double patterning** and **pitch doubling** technology.
- Duration:
  - 3 years
- Resources:
  - 200 man years
- Partners:
  - Semiconductor Industries: Numonyx, Qimonda, ...
  - Litho and masks: ASML, DNP Europe, AMTC,...
  - Metrology, resist: KLA, Nova, JSR, FEI....
  - Data Handling and OPC: Mentor,...
  - Universities/research centers:
- Countries:
  - Italy, France, Holland, Germany, Israel,...

# Lithography *Continued...*

- Numonyx proposal: Lithography beyond 32nm (II):
- Two possible approaches:
  - Double exposure with dedicated masks
  - Pitch doubling with masking spacers
- Advantages:
  - Use of conventional equipment and mask technology
  - Limited risk
- Disadvantages:
  - Increase cost of masking step
  - Suitable only for regular structures.
- Others:
  - EUV process as benchmark?

# Lithography *Continued...*

- *Vistec proposal: Common E-Beam Platform*

## 1. Nano Fab Approach

-To enable Europe's industry to stay at the forefront of electronics developments & applications through chip making, integration and embedded systems capabilities with adapted volume process chains for cost effective manufacturing

## 2. Nanometer Scale Lithography & Process & Control

- wafer and lithography mask positioning
- high resolution & rapid imaging and metrology
- lithography process control
- multi beam technology (MBT)

# Lithography *Continued...*

- *Applied materials proposal:*
  - DFM driven process control
    - CD SEM
    - Wafer inspection
    - Mask inspection

Should be integrated in the Litho (DP) project

# Lithography Continued...

- Other possible project topics (No concrete proposals yet):
  - EUV source for HVM (100W)
    - CATRENE (Zeiss, ASML,..)
  - EUV resist development
    - resist and process development (including mask)
  - Set up ML2 platform--→next call (2009)
    - becomes generic common e-beam platform (litho, metrology, process control, ) (Vistec, Applied, Zeiss,..)
  - New lens material development for 193i
    - extension of immersion litho (Numonyx, Qimonda,.. )
  - Self Assembly lithography
    - part of resist or extension litho projects
  - DFM
    - Advanced Process Control on Manufacturing

# Assembly for SiP

- **Some High Level Areas for R&D Projects:**
  - **Beamind** contactless electrical metrology => upgrade resolution (100µm) , thruput of the machine (300 measurement/s)
  - **Infineon** => Automotive application, high temp ambient (175° ), WLP , kgd, advanced process reliability measurement
  - **Suss Microtech** priorities, temporary bonding wafer, Litho for Vias, new items die to wafer
  - **AMS** WLP, with analog
  - **TRT** microwave packaging simulation testing demonstrator , from few Mhz to 100 GHz low volume
  - **CEA** developing enabling techno TSV, Wafer to wafer and die to wafer design for manuf and characterisation
  - **FEI** metrology around TEM SEM FIB litho, micromachining with FIB for failure analysis
  - **Wacker** 150 mm to 300 mm compatibilty with thickness goal 20 µm
  - **Delft Uni.** Thermal mngt MEMS techno Testing group heterogeneous int., reliability... flexible substrate
  - **ASM** Facilitator
  - **Europe** Barrier & seed , High k, Back end pick & place bonding, thin wafer handling
  - **BESI, Boschman, Assembleon** dutch companies on back end
  - **SEMI Europe** Facilitator acting on behalf of their members
  - **Jemi** Facilitator acting for **ALES, AMMS, Fogale, Nanoplas, SET, ...**

# Assembly for SiP *Continued...*

- WLP (Wafer Level Packaging) and 3D Technologies
  - Users **Infineon, Numonix, AMS, ST, Qimonda (?), NXP**
  - Through Silicon Vias (TSV): via first/via last, ...**AMMS, STS, Aviza, Xsil**
  - Dicing **Synova, Jenoptik**
  - Die to wafer and/or wafer to wafer F/F, F/B, ... **EVG, Datacon, SET, Suss, ASM**
  - Wafer Thinning and associated handling **SEZ, Peter Wolters**
  - Seed & Barrier Layers **ASM, Alchimer,**
  - Metal filling **Replisaurus, Semitool,**
  - Dielectrics **ASM,**
  - Metrologies
    - chemical – **Cameca, Jordan, Valley**
    - physical – **Zeiss, Jobin Yvon, KLA, AMAT, FEI**
    - electrical - **Beamind, ATG, Suss, Mania,**
  - Thermal Management **Insidix, Soft modeling comp.**

# Assembly for SiP *Continued...*

- **Application oriented**
  - Memories
  - Heterogeneous integration
- **Technonology oriented**
  - Vias
  - Thinning
  - Filling
  - Characterization
  - Design
  - Failure analysis

# Manufacturing Science

- **IMPROVE Project** (Implementing **M**anufacturing science solutions to increase equipment **PRO**ductivity and fab **pE**formance)
  - Duration: 3 years
  - Scope: Virtual Metrology and Predictive Equipment Behaviour
  - Expected Achievements
    - To improve processes reproducibility
    - To improve the effectiveness of production equipments
    - To shorter cycles time
  - Possible Consortium:
    - Core group members (Infineon, Intel, Numonyx and ST) + other IC manufacturers (ATMEL, AMS?) + Foundries (X-Fab?)
    - Institutes & Labs (expertise in manufacturing science and statistics)
    - SME's (Decision systems and software providers, sensors makers...)

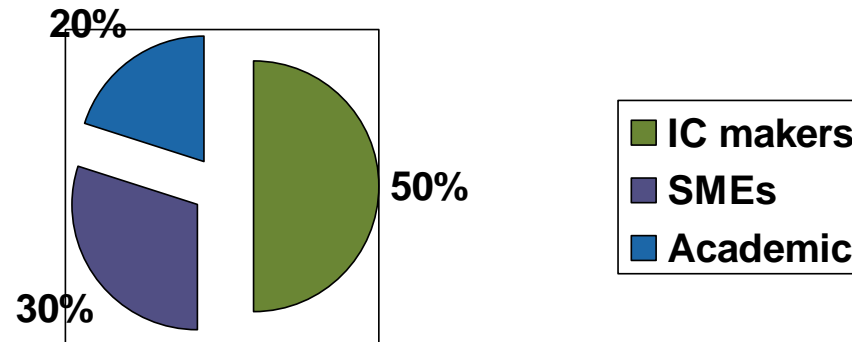
# Manufacturing Science *Continued...*

- Progress vs State of the Art
  - Virtual predictive metrology versus traditional metrology
  - Dynamic preventive maintenance/static
  - Formal links between manufacturing, process and equipments engineering
- Partners (preliminary list)
  - Core group members (Infineon, Intel, Numonyx, ST) + other IC manufacturers (ATMEL, AMS?) + Foundries (X-Fab?)
  - Institutes & Labs
    - Fraunhofer (G)...
    - CMP-GC (F), G-Scop (F), Univ. Pavia (I), University of Munich (G) ...
  - SME's
    - TechnoFittings (I), Fluent (I), LAM (I), Adixen (F), OSLO (F), MASA (F), PDF solutions (F), CAMLine (G), ProBAYES (F)...

# Manufacturing Science *Continued...*

## Tentative Budget Distribution

Tot. Budget 40 - 50M€



# Manufacturing Science *Continued...*

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- Work Packages Description
  - Virtual and Predictive Metrology
  - Predictive Equipment Behavior (Predictive Maintenance)
  - Dynamic Risk Assessment and Control Plan
  - Virtual Fab Software
  
  - Survey & Integration in decision systems
  - Project Management & Dissemination of results

# Manufacturing Science *Continued...*

- Virtual and Predictive Metrology
  - to improve reproductibility of parameters of wafer devices (physical and electrical characteristics) through better process control
  - To reduce cycle time through non-value added steps removal
  - This will be achieved by developing and assessing methods to replace or complement traditional metrology steps by predictions based on process equipment parameters and/or measurement results.

# Manufacturing Science *Continued...*

- Predictive Equipment Behaviour (Predictive Maintenance)
  - to improve effectiveness (“health monitoring”)
  - to decrease equipment failure rate (unscheduled down time)
  - To speed up equipment recovery through root cause identification
- This will be achieved by developing and assessing methods to predict and anticipate future failures based on the analysis of equipment parameters and history.

# Manufacturing Science *Continued...*

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- Dynamic Risk Assessment and Control Plan
  - to improve the process reproductibility and reduce the cycle time by adapting the control plan to the dynamic assessment of risk
  - This will be achieved by developing the dynamic risk evaluation algorithms and interfaces with the line decision systems.

# Manufacturing Science *Continued...*

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- Virtual Fab Software
  - To enable IDMs to identify black areas on the architecture of their manufacturing lines
  - This will be achieved by providing a SW to enable IDMs to visualize the complexity of information in the manufacturing lines and such easily identify missing connectors for quantitative root cause description.

# Manufacturing Science *Continued...*

- Topics discussed on April 22nd:
  - FhG
    - Leadership of "Virtual Fab. modeling" activity
    - Proposal for "Benign Manufacturing" topic
    - Link with DFM/FDM (in Dynamic Risk Assessment?)
    - Link or integration of SEANET like project or task
  - Intel
    - Leadership of VM (Virtual Metrology) Working Package
  - Memsstar
    - Need to involve MEMS Manufacturers
  - Applied Materials
    - Involvement of Eqt manufacturers for understanding of needs (mainly PM)

# Manufacturing Science *Continued...*

- Topics discussed:
  - ST (Rousset)
    - Main interest 25% VM, 75% PM
- Still to be discussed
  - ATMEL
    - Leadership of "Predictive Eqt behaviour" tbc.
  - INFINEON
    - Leadership of "Survey& Integration in decision systems" tbc. .