

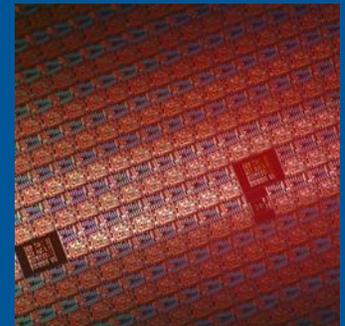


Accelerating the next technology revolution

Lithography Industry Collaborations

SOKUDO Breakfast
July 13, 2011

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SEMATECH

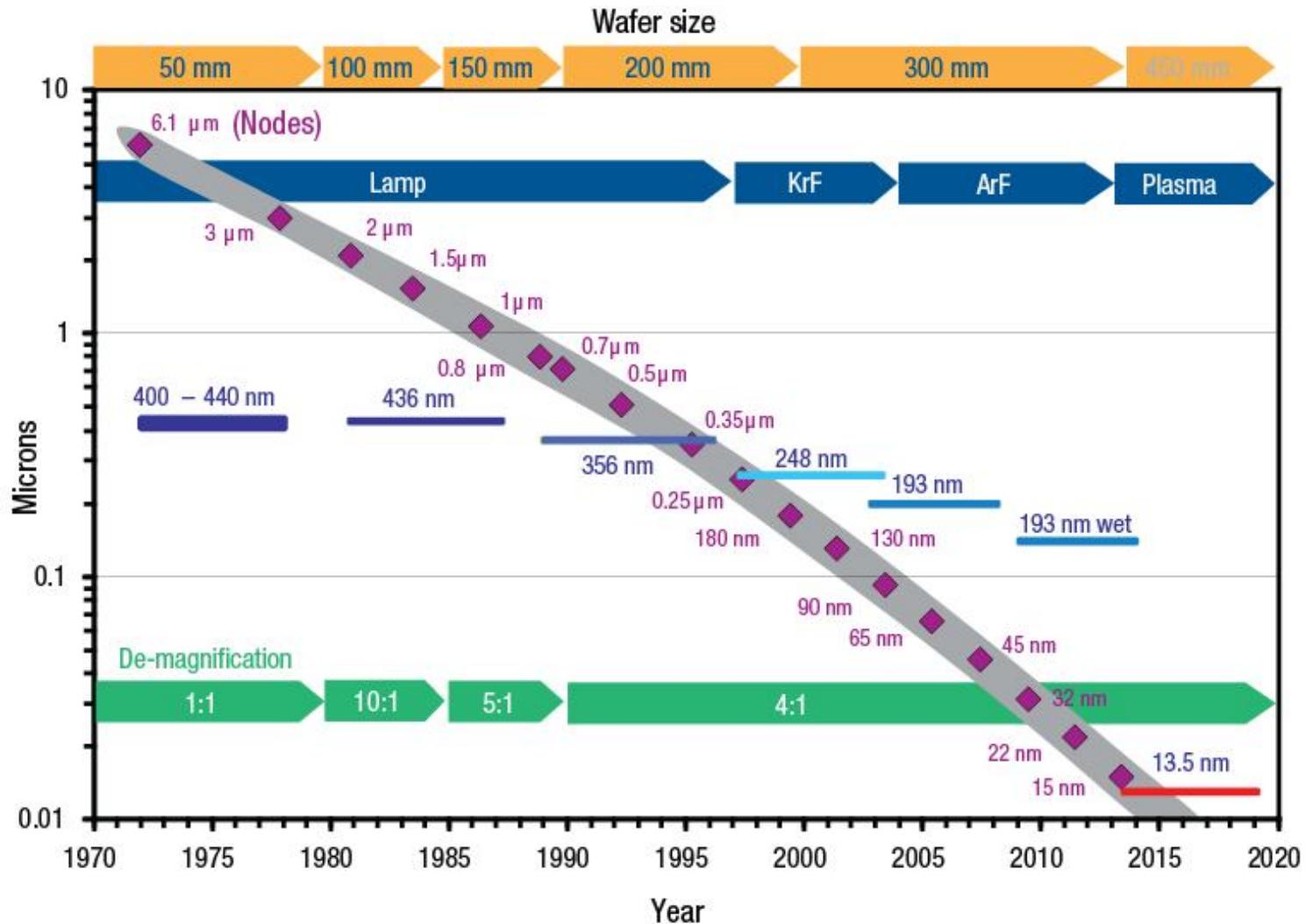


Outline



- Drivers of collaboration in lithography
- Collaboration at consortia
- Outlook

Lithography scaling challenges drive collaboration



The challenges of infrastructure development drive collaboration

- Developing the materials and tools technology infrastructure for a new lithography:

Takes many years to mature to manufacturing readiness

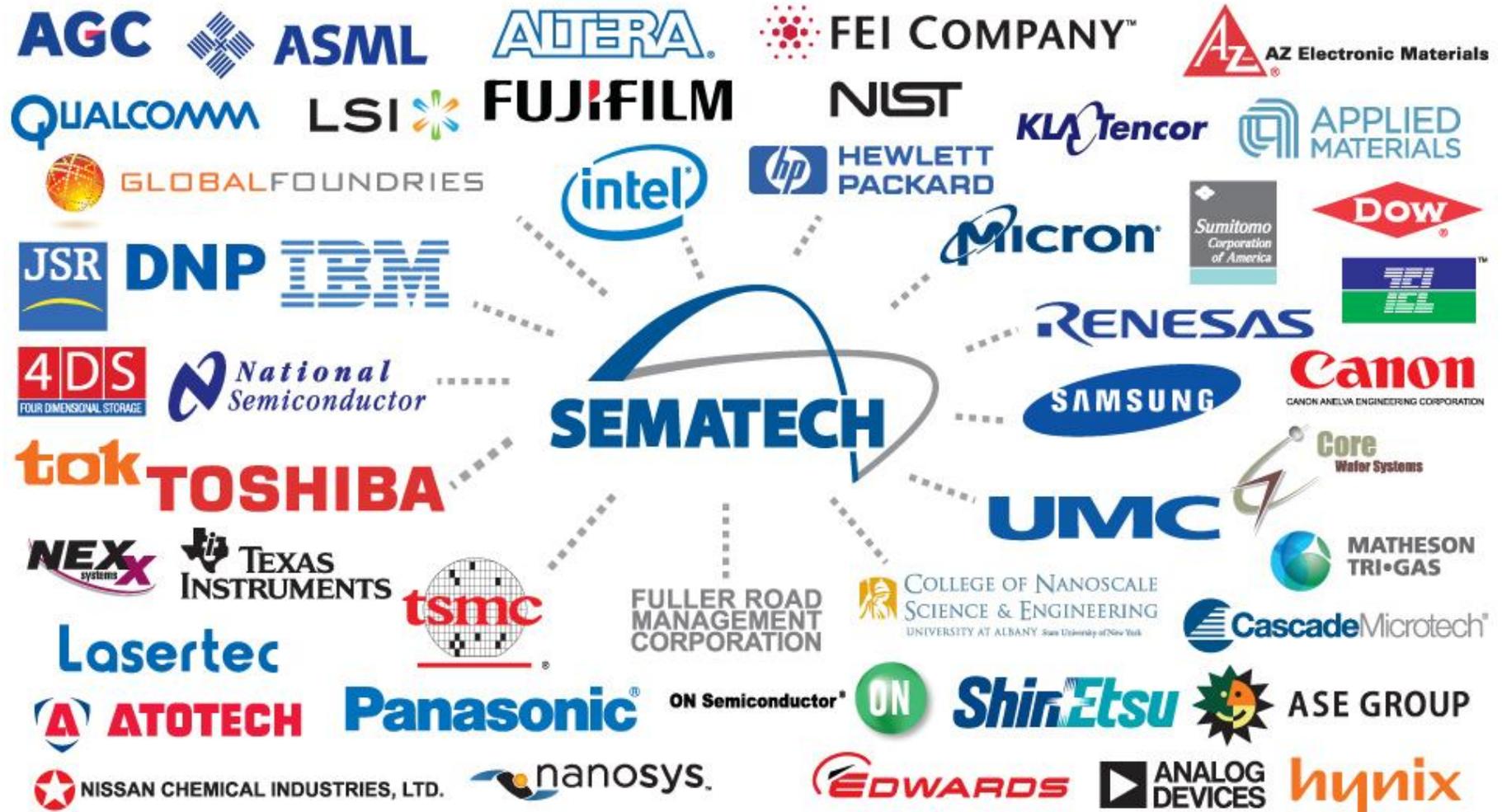
Costs many millions to billions of \$, €, NT\$, ₩, ¥

Has risk of failure: Scalpel, X-ray, Prevail, IBL, 157 nm...

Transition challenges drive collaboration

- The costs of lithography scaling and technology transitions keeps increasing
- Fewer materials and tool suppliers can afford the up-front investments needed to keep pace
- The industry is facing unique transition challenges
 - Must meet a technology challenge - EUV
 - Must meet a scaling challenge – Defects
 - Must meet a cost challenge - 450 nm
- Meeting each of these challenges requires industry collaboration and leadership

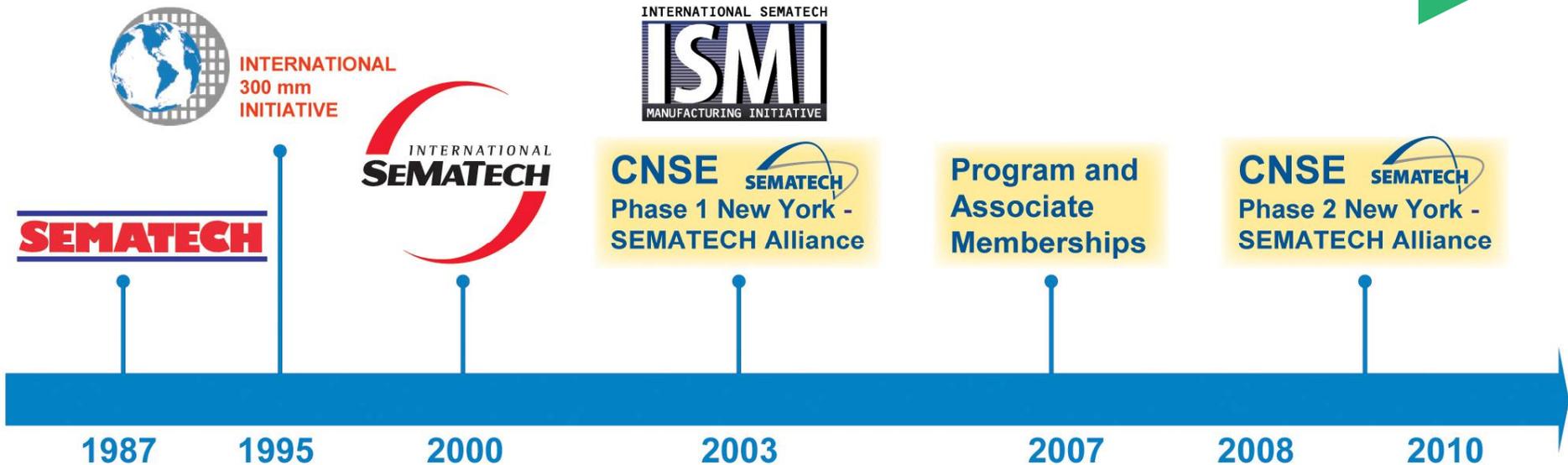
SEMATECH and ISMI - worldwide collaboration is our business



SEMATECH evolution



Increasing collaboration throughout supply chain



Contributions

- Helped stabilize US based players
- 300mm wafer size transition
- Mfg. productivity improvements
- Infrastructure for next generation technologies

Directions

- US only to global consortium
- Greater manufacturing focus
- Supplier participation
- Leveraged funding

Consortia lithography collaborations enable early tools and tool access

Mask tool availability for pilot lines start & technology ramp-up

- SEMATECH
 - 65 nm node mask repair (FEI)
 - 157 nm AIMS (Carl Zeiss)
 - Patterned mask inspection (KLA-Tencor)
 - 193 / 193 immersion AIMS (Carl Zeiss)
 - Overlay metrology < 32 nm (Carl Zeiss)
 - **EUV AIMS (Carl Zeiss) New !**
 - Fast mask writer (considered)
 - EUV mask blank deposition (considered)
- Selete
 - 65 nm node mask repair (SII Nano-Technology)
- EIDEC
 - Blank Inspection (Lasertec)

Tool access for early materials development & process learning

- SEMATECH
 - 157 nm MET (Exitech)
 - 193 immersion MET (Exitech)
 - 0.3 NA EUV MET Albany (Exitech)
 - 0.3 NA EUV MET Berkeley (LBNL)
 - 0.25-0.35 NA AIT (LBNL)
 - Two 0.5 NA EUV METs (TBD)
 - 0.5 NA AIT (LBNL)
- CNSE
 - 1150i (Albany, ASML)
 - 0.25 NA ADT (Albany, ASML)
- Selete
 - 0.3 NA EUV MET (Tsukuba, Canon)
 - 0.25 NA EUV1 (Tsukuba, Nikon)
- IMEC
 - 0.25 NA ADT (Leuven, ASML)



EUV Lithography is a game changer for collaboration approaches

- EUV exposure tool infrastructure for materials development is very costly and requires unique expertise
 - SEMATECHs Resist and Materials Development Center (RMDC) offers a collaborative industry environment to help enable the development pipeline for materials suppliers
- Enabling defect free EUV mask blanks and closing the EUV mask inspection and review tool gaps require leadership in collaboration
 - SEMATECHs Mask Blank Development Center (MBDC) helps enable mask blank suppliers to achieve defect free mask blanks
 - SEMATECH EUV Mask Infrastructure (EMI) Partnership provides a new business model for the industry to enable tools that have high development costs and only a small market

SEMATECH's Resist and Materials Development Center (RMDC)



- Provides world-class EUV imaging capabilities to participating companies and organizations – it is an open participation model
- 24/7 operation, support for member company experimental plans, and an EUV research effort concentrating on novel approaches



SEMATECH ADT
(0.25 NA, 25 nm HP)



SEMATECH Albany
MET (0.3 NA, 20 nm HP)



SEMATECH Berkeley
MET (0.3 NA, <20 nm HP)



NISSAN CHEMICAL INDUSTRIES, LTD.



ASML



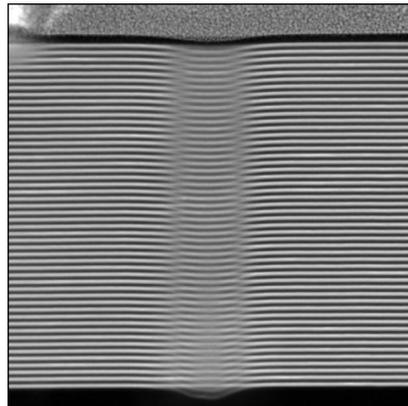
SEMATECH's Mask Blank Development Center (MBDC)



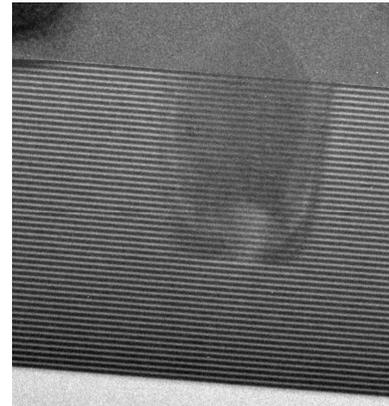
- State of the art tool set and advanced analytical capabilities to enable defect learning and defect reduction
- Provides collaborative industry environment for participants to prepare for EUV mask blank production



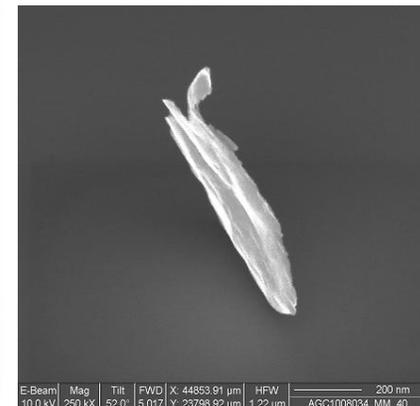
Blank defect caused by substrate bump



Blank defect caused by substrate pit



Blank defect added during ML deposition



Particle added on top of EUV Multilayer (ML)



SEMATECH EUV Mask Infrastructure (EMI) Partnership – a new industry model



Gap	Suppliers Building Solution?		HVM Solution Funded?		Time to HVM Solution
	Before EMI	After EMI	Before EMI	After EMI	
Mask Blank Actinic Inspection	No	Yes (1 supplier)	No	Funded by Japanese Consortium (EIDEC)	2013
Mask Defect Review	No	Yes (1 supplier)	No	Funded by SEMATECH EMI Partnership	2014
Patterned Mask Inspection	No	Yes (4 suppliers)	No	Supplier / customer funded	2013-15

- SEMATECH EMI initiative was successful in leading the industry to close the EUV mask infrastructure gaps
 - Commercial actinic blank inspection solution meeting memory manufacturer needs through EIDEC – will need to be extended to meet all industry needs (memory, logic, and foundry)
 - SEMATECH EMI partnership enables commercial tools through JDA with Carl Zeiss
 - SEMATECH EMI effort galvanized supplier-led tool development programs (AMAT, HMI, KLA-Tencor) and EIDEC / EBARA work on tool development

An outlook on collaboration



- Lithography infrastructure development will see more collaboration going forward and not less
 - Cost, complexity, and the risk associated with major technology transitions in the industry drive collaboration
- Collaboration on infrastructure development and pre-competitive research is becoming the norm and not the exception
 - Device manufacturers have been pioneering this collaboration approach at places like SEMATECH
 - Collaboration at consortia like SEMATECH has expanded to include all elements of the lithography supply chain - in equal partnerships rather than in traditional supplier customer relationships

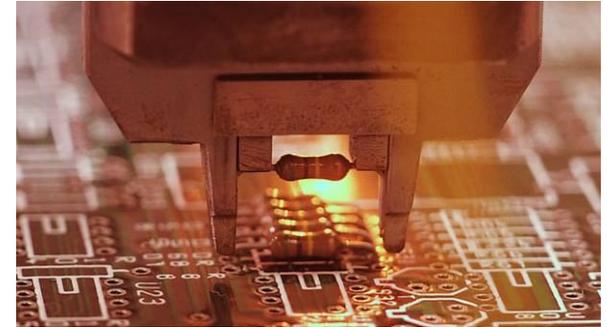
Accelerating the next technology revolution



Research



Development



Manufacturing

