Some history of joint academic, industry, and government research programs for advanced semiconductor manufacturing in Albany New York

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17th Global Commercialization Conference
November 6, 2024
KAIST, Daejeon

This is a what I have seen and learned about Industry, Government, and Academic partnerships in 20+ years at Albany

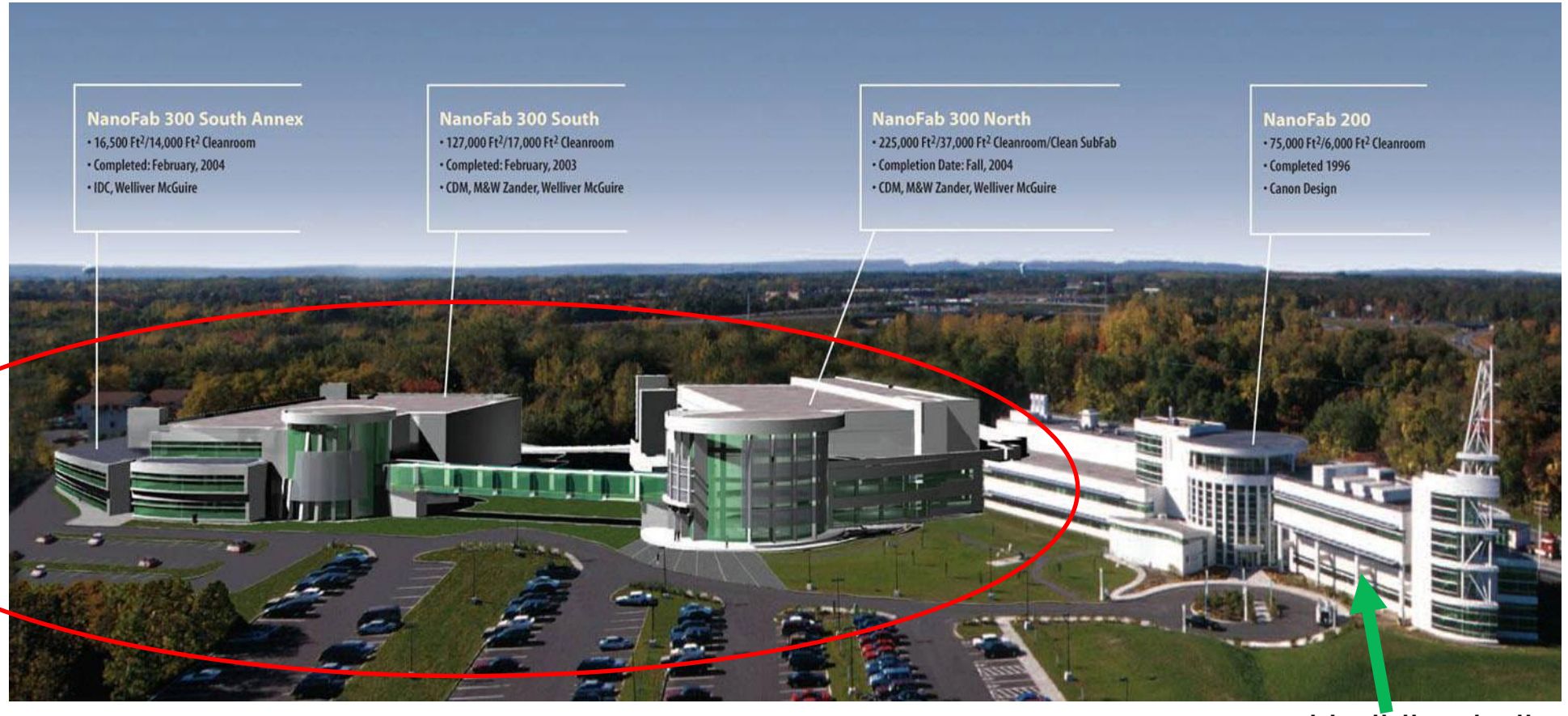
I study fundamentals of EUV photoresists for lithography, nanoparticles for defectivity reduction

But today I am here about Industry, Government and Academic partnerships

I did some of the science and engineering to support these programs, helped implement some of these, taught students,

but I was NOT responsible for making these programs happen

How did we go from this in ~ 2002



Drawings of plans for buildings

Real building built 1996 for mostly other purposes

To this in 2024

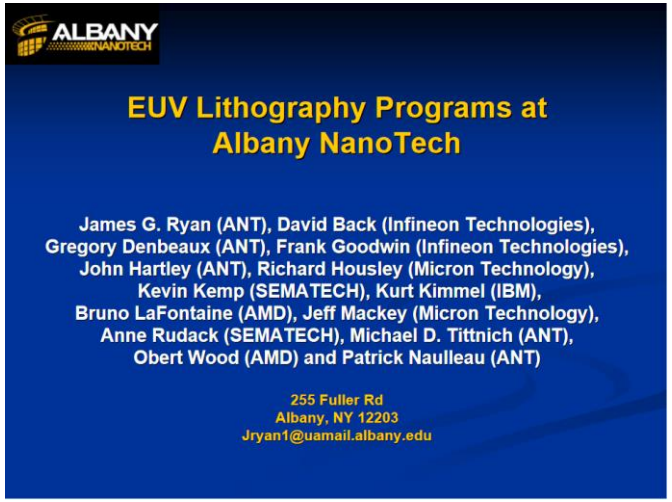
https://ny-creates.org/ny-creates-campus-complex/

It took many partnerships between academics, industry and government

ANT's Strategic Partnerships with Industry

- SEMATECH North
  - $403M program announced 7/02
  - Focus on EUV Lithography Infrastructure
- TEL Technology Center America (TTCA)
  - $300M program announced 11/02
  - Focus on equipment and process technology R & D
- International Multiphase Prog. for Lithography Science and Engineering (IMPLSE)
  - $400M program with ASML, IBM & ANT, announced 1/05
  - Focus on 193 nm immersion and EUV
- IBM R&D Center
  - $450M program announced 1/05
- International Nanoelectronics VENTure (INVENT)
  - $600M program with IBM, AMD, Infineon, Micron & ANT, announced 7/05
  - Focus on 193 nm immersion and EUV
- AMAT-IBM-ANT
  - $300M program announced 9/05
  - Focus on materials, process, and equipment technology

Slide from 2005 EUVL Symposium


EUV Lithography Programs at Albany NanoTech

James G. Ryan (ANT), David Back (Infineon Technologies), Gregory Denbeaux (ANT), Frank Goodwin (Infineon Technologies), John Hartley (ANT), Richard Housley (Micron Technology), Kevin Kemp (SEMATECH), Kurt Kimmel (IBM), Bruno LaFontaine (AMD), Jeff Mackey (Micron Technology), Anne Rudack (SEMATECH), Michael D. Tittnich (ANT), Obert Wood (AMD) and Patrick Naulleau (ANT)

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https://euvlsymposium.lbl.gov/pdf/2005/pres/07%201-ET-15%20Ryan.pdf

I worked in this program and Will talk in more detail

Requirements for success

The program has to benefit <u>all</u> participants

- Government
  - Jobs, jobs, jobs
- Academic
  - Solve science and engineering problems
  - Train students for future workforce
- Industry
  - save research funds with cost-sharing
  - advance technology to enable future profits

also needs to be pre-competitive research

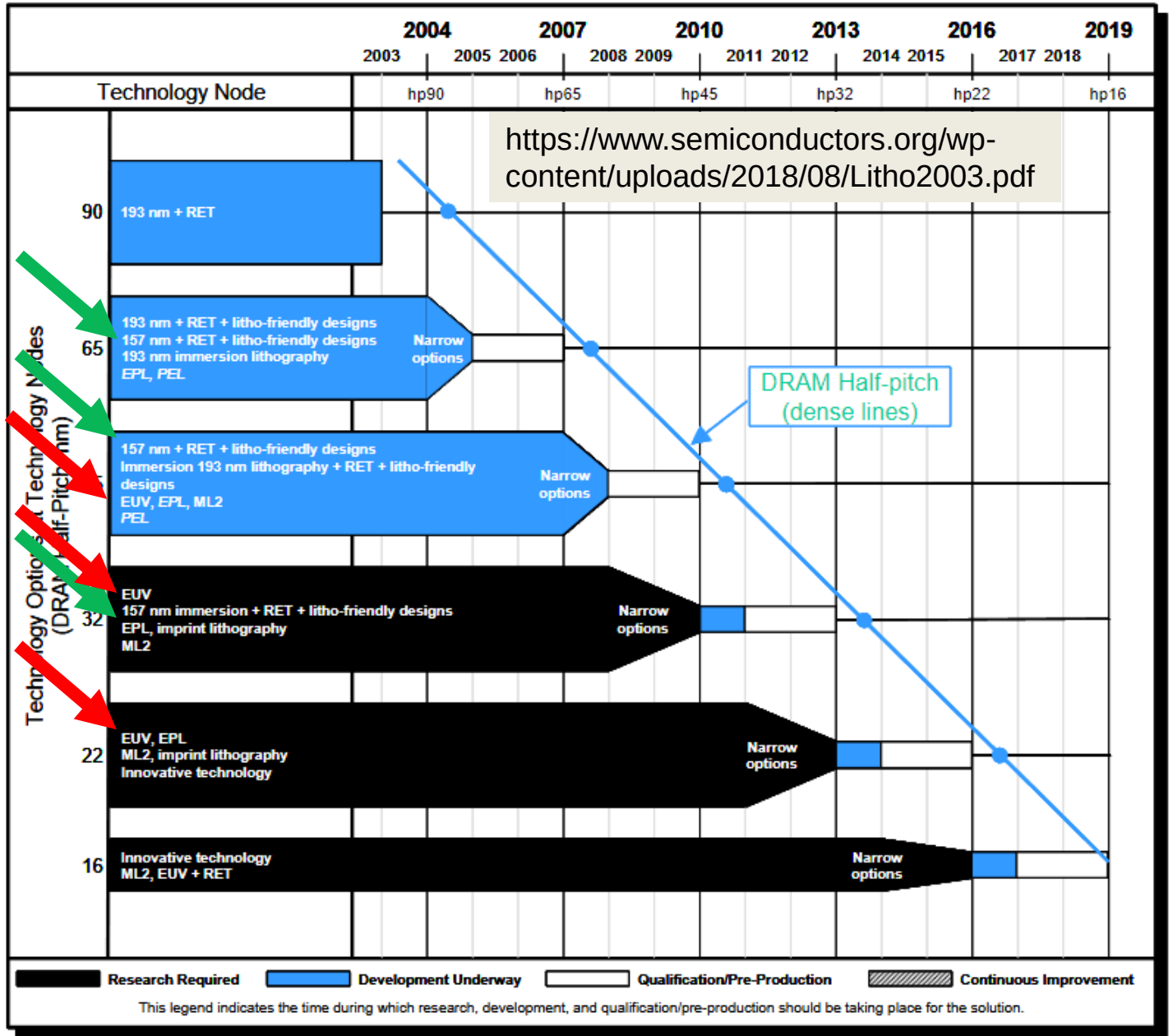
also need contracts and intellectual property (IP) protection (often painful process)

From 2003 ITRS Roadmap

157 nm lithography in green

EUV lithography in red

Immersion lithography was not even on the roadmap!



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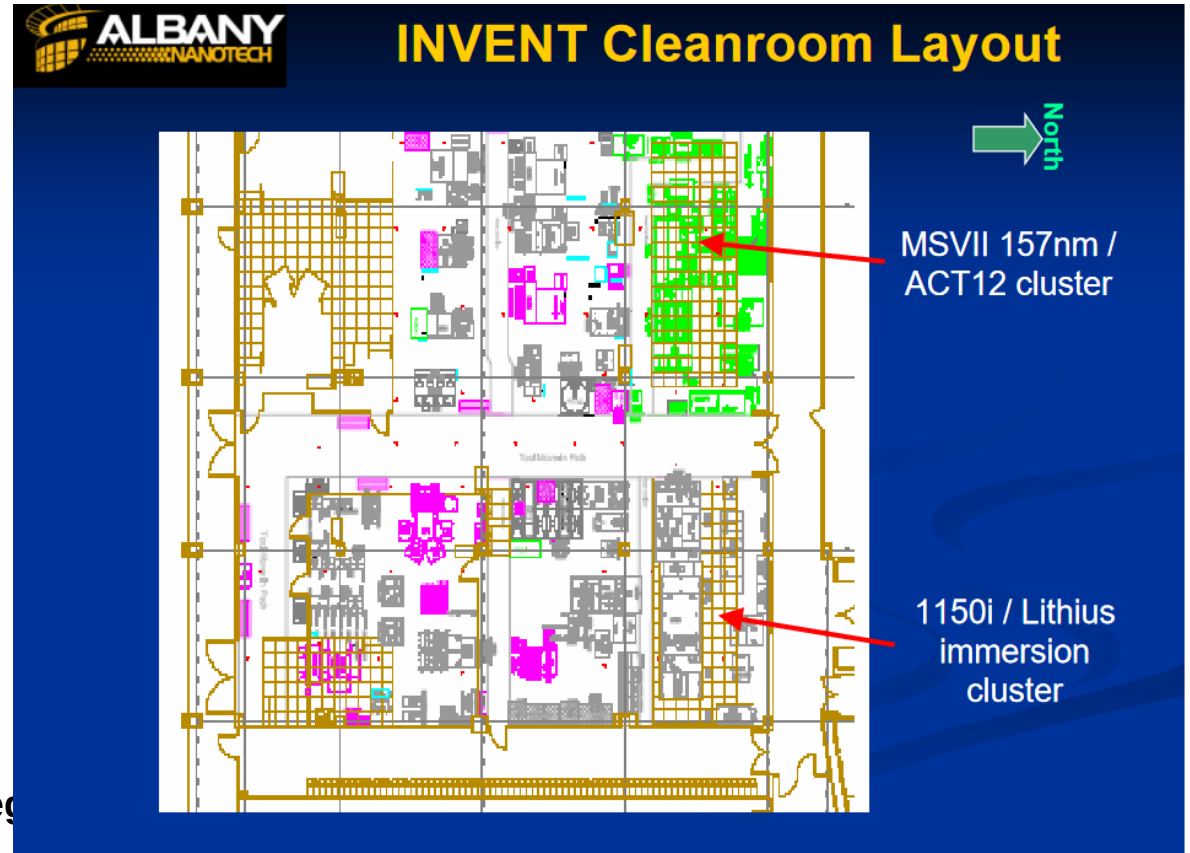
INVENT program

Have a plan:
Focus on ~~157 nm lithography~~ and EUV lithography

Change that plan along the way – be adaptable!
-> Focus on immersion lithography and EUV lithography



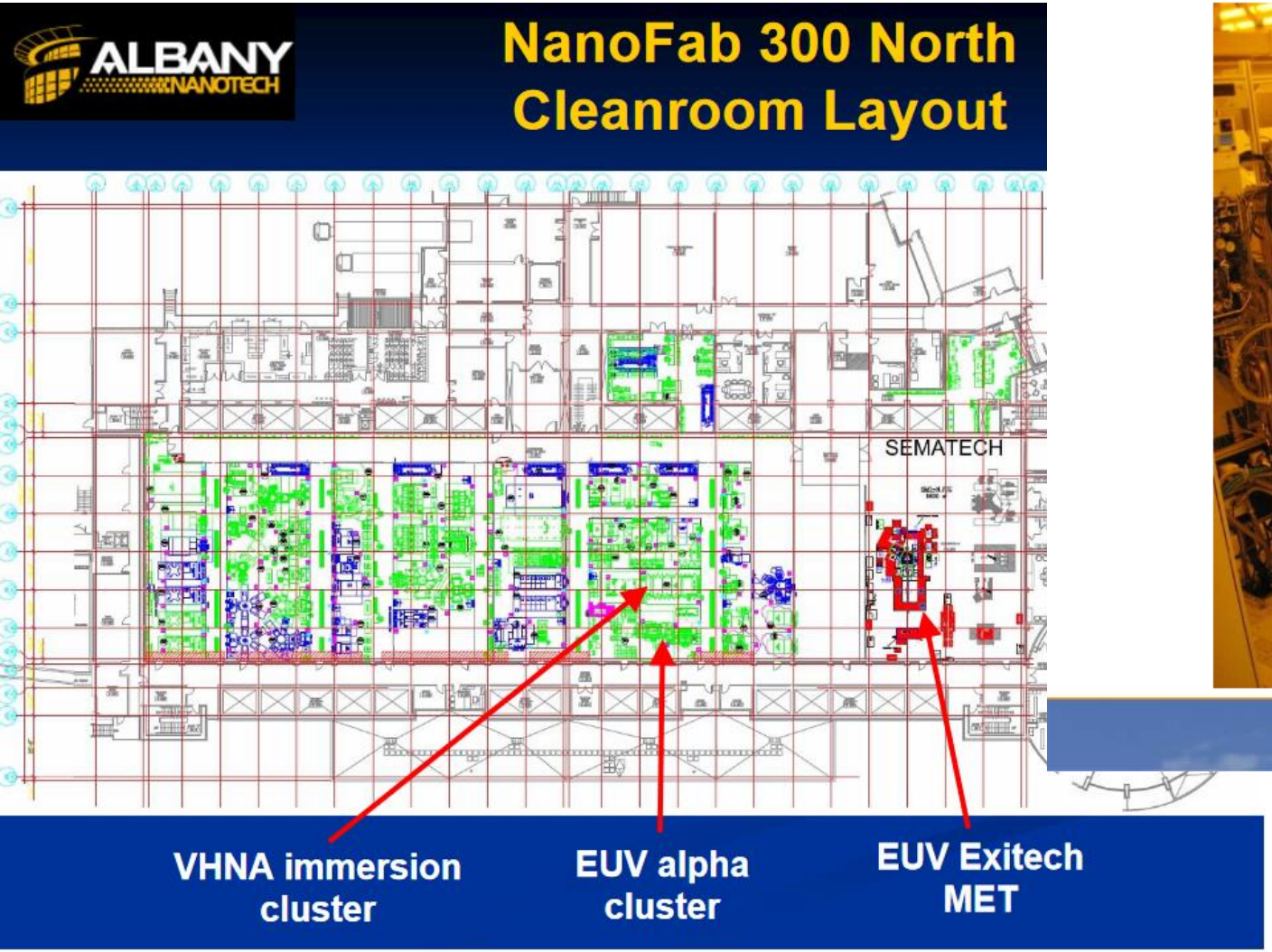
Remove 157 nm lithograph tool

Install first ASML immersion lithography tool!

https://euvlsymposium.lbl.gov/pdf/2005/pres/07%201-ET-15%20Ryan.pdf

In the other cleanroom keep working on EUV lithography

https://euvlsymposium.lbl.gov/pdf/2005/pres/07%201-ET-15%20Ryan.pdf



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Micron · qimonda · AMD · IBM

ASML EUV Alpha Demo Tool in Albany

INVENT

https://euvlsymposium.lbl.gov/pdf/2007/ET-02-Hartley.pdf

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Requirements for success (repeat)

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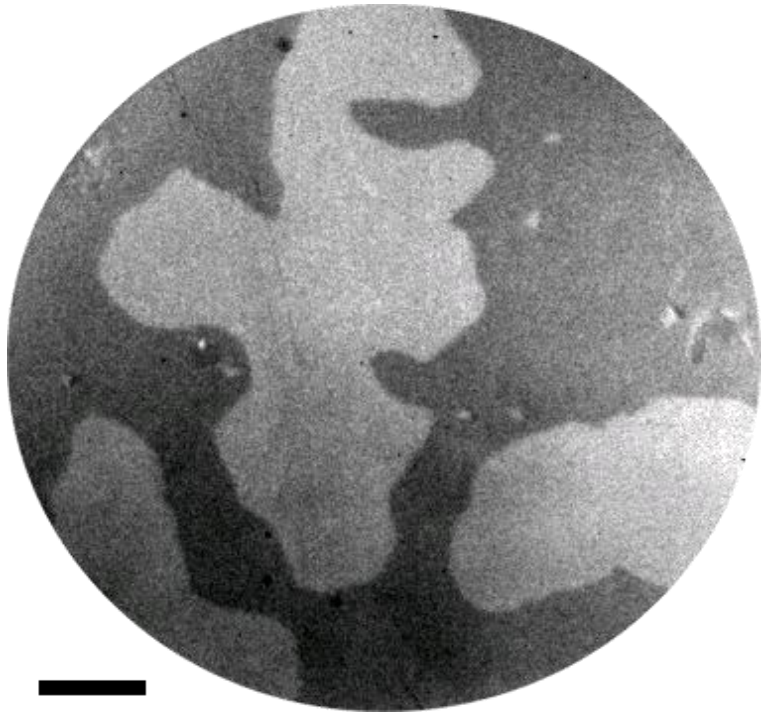
What about other industries

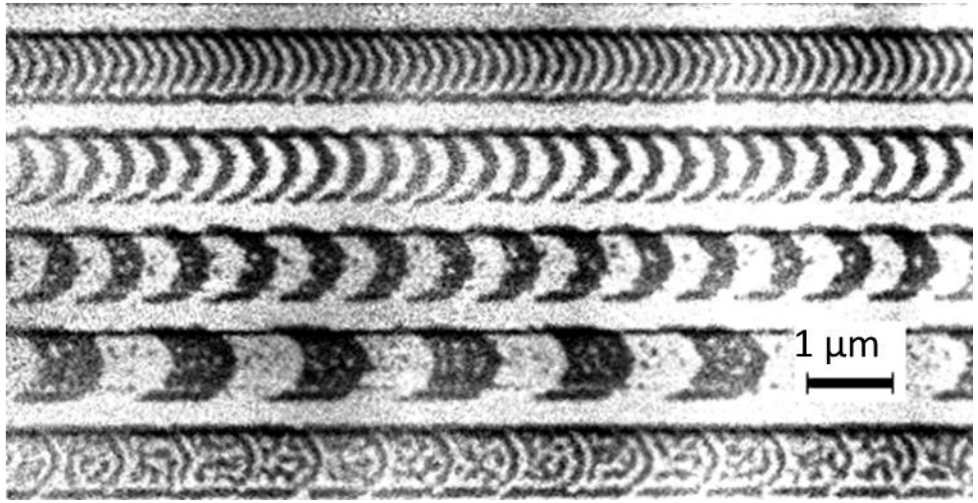
I used to do x-ray microscopy with magnetic circular dichroism and did research with the magnetic recording industry

Fe L_3 (704eV)



$Fe_{75}Gd_{25}$

100 nm lines & spaces



Out-of-plane thermomagnetically written bits in a magneto-optical disk (FeTbCo)

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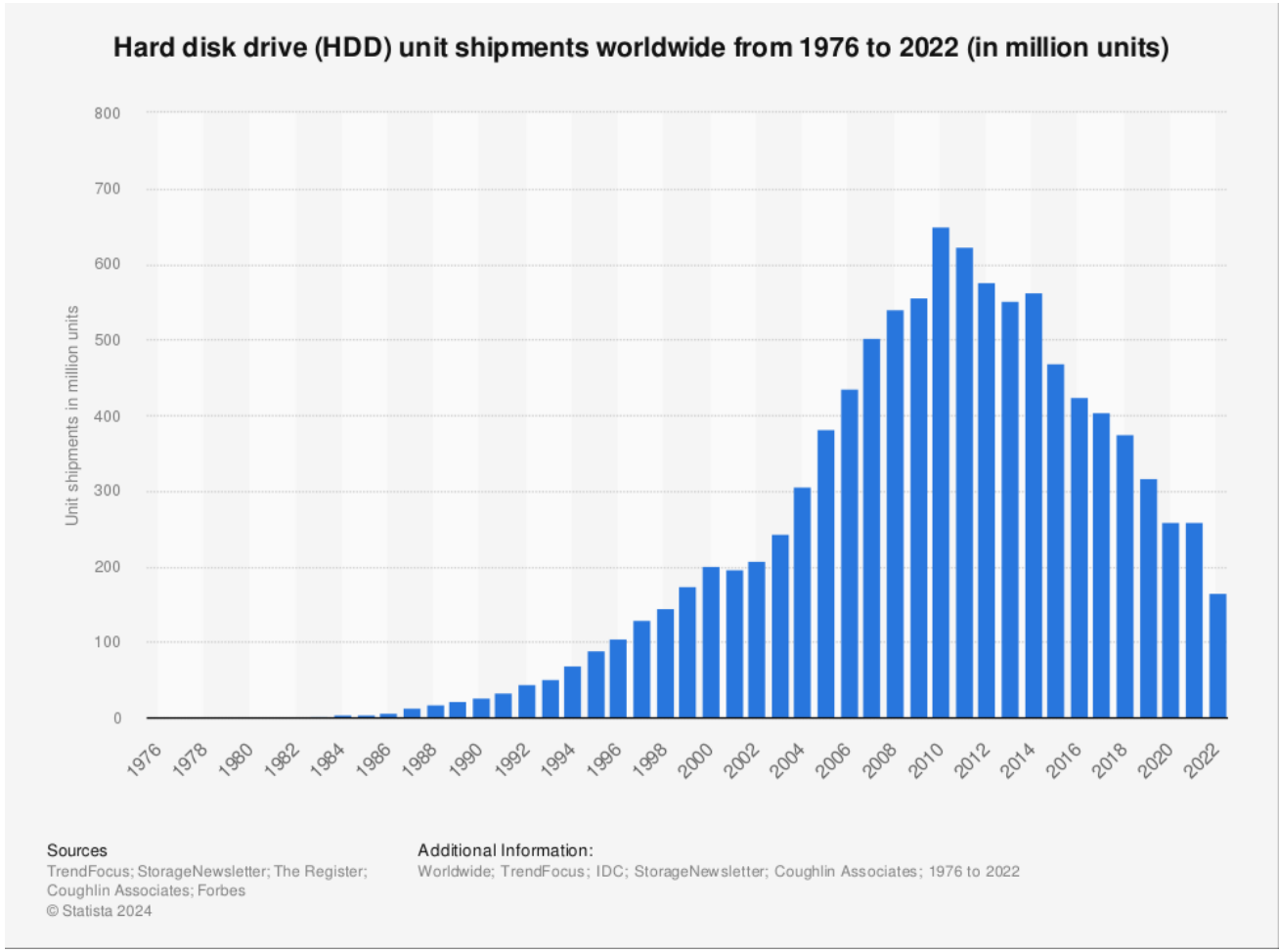
So, I thought it would be a good idea to start another Industry, Government, Academic partnership in magnetic recording



https://www.statista.com/graphic/1/398951/global-shipment-figures-for-hard-disk-drives.jpg

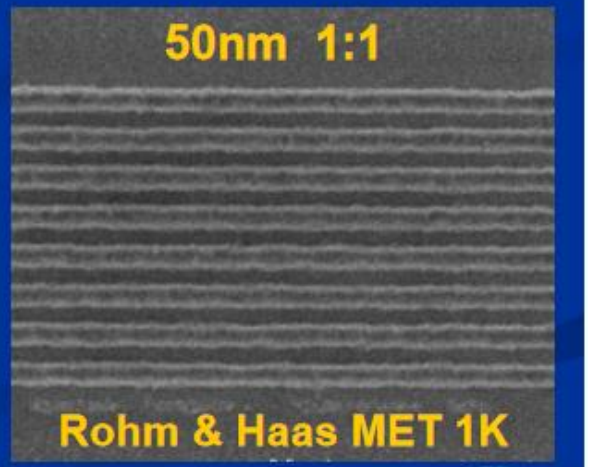
But that will not work when the profit margins are too low and the market is crashing…

What about other sharing models – the SEMATECH EUV Resist Test Center

SEMATECH North EUV Resist Test Center

- The EUV Resist Test Center supports development of resists meeting production requirements. The EUV RTC can also support mask development
- The EUV RTC will accelerate EUV resist development by providing processing infrastructure to resist researchers.

Exitech MS-13 EUV Microstepper



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2005 SEMATECH membership: Samsung, AMD, Freescale, Hewlett-Packard, IBM, Infineon, Intel, Panasonic, Philips, Spansion, TSMC, Texas Instruments

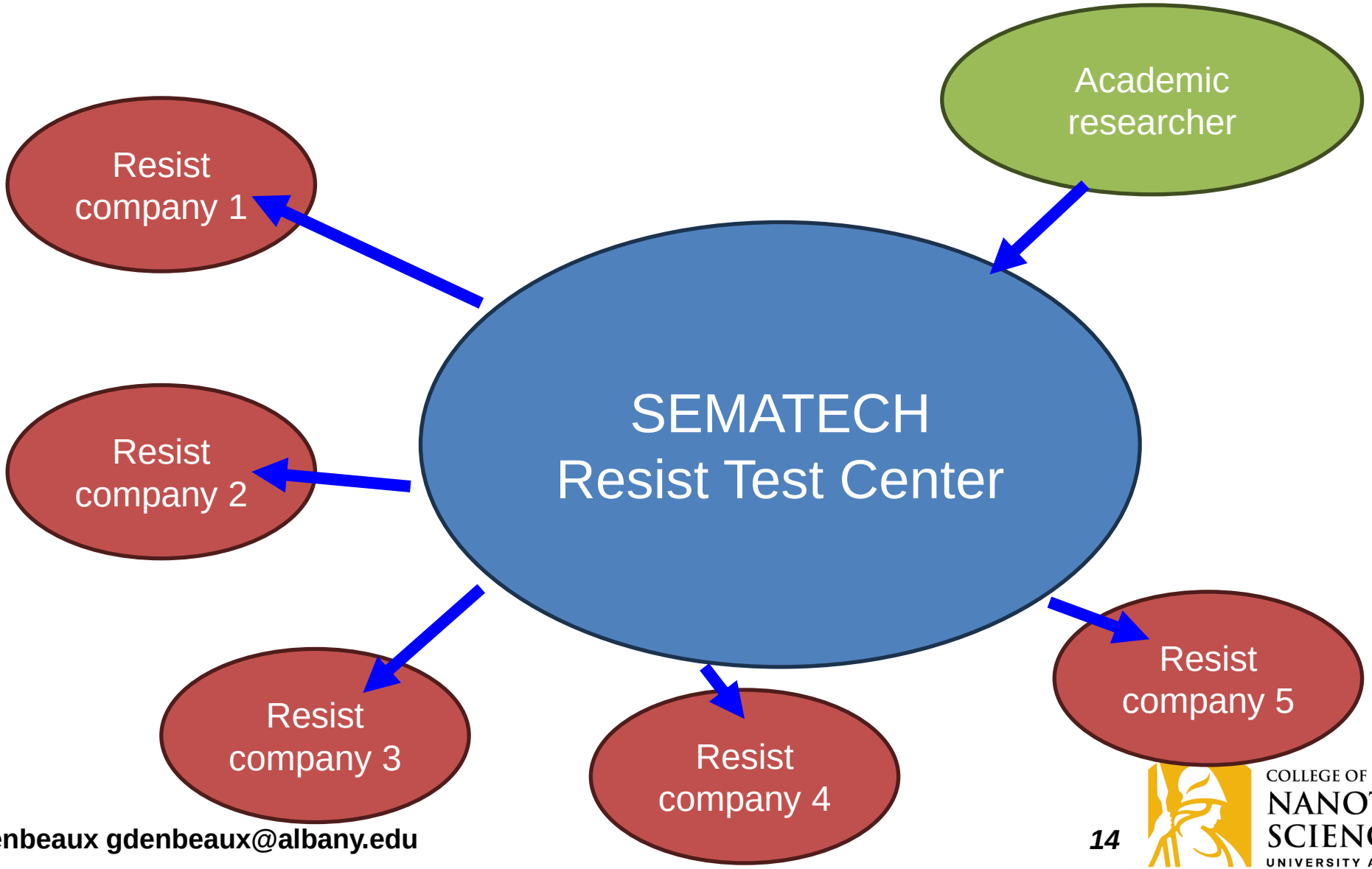
https://sst.semiconductor-digest.com/2005/09/samsung-joins-sematech-consortium/

Most major resist suppliers participated in the SEMATECH Resist Test Center

Who pays for the program?

As an academic, the SEMATECH Resist Test Center was great

I could do research that benefited multiple companies through a common program



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It has been an interesting journey
Any questions?

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