
Improving Microelectronics/Semiconductor Industry

Performance with Academic Research

James Meindl

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Performance with Academic Research

through

Semiconductor Research Corporation (SRC)

Georgia Tech MiRC



Semiconductor Research Corporation (SRC)

- Based in Research Triangle Park, NC; Established in 1982
- Operates Globally
- To Provide a Competitive Advantage to Its Member Companies
- To Deliver Early Research Results
- To Develop Relevantly Educated Technical Talent
- Funded More Than \$500 million in Long Term Contracts
- Over 100 Participating Universities

SRC Member Classifications

- Ten Members
- Six Science Area Members
- One Adjunct Member
- One Associate Member
- Two Affiliate Members
- Four Government Participants
- Two Strategic Partners

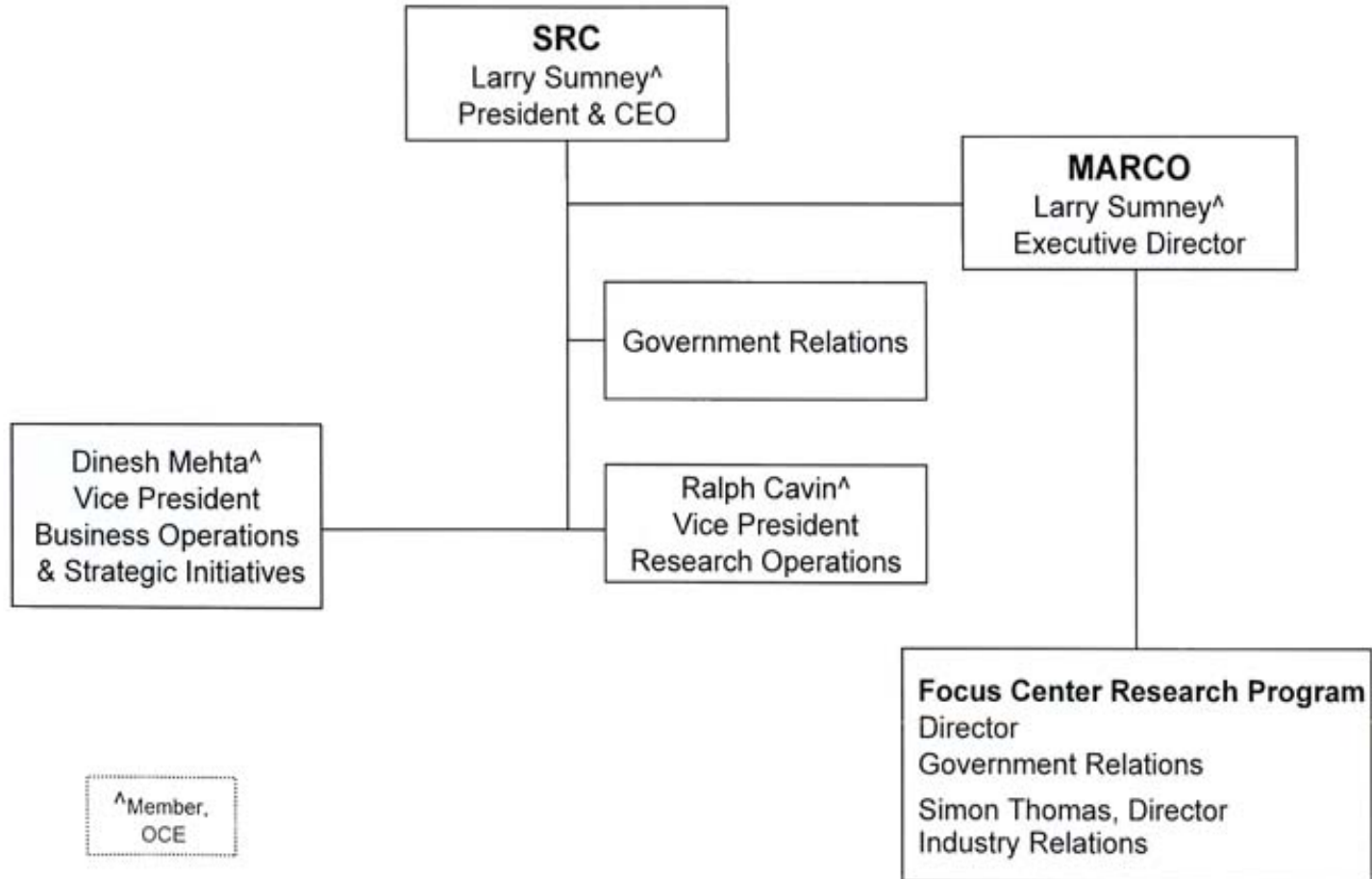


SRC Member Corporations

- Advanced Micro Devices, Inc
- Agere Systems
- Chartered Semiconductor Mfg
- IBM Corporation
- Intel Corporation
- LSI Logic Corporation
- Motorola, Incorporated
- National Semiconductor Corporation
- Texas Instruments Incorporated
- United Microelectronics Corporation



SRC Executive Management Team



^Member,
OCE



Microelectronics Advanced Research Corporation (MARCO)

Focus Center Research Program

Microelectronics Advanced Research Corporation (MARCO)

Focus Center Research Program

- **Gigascale Design and Test**
- **Circuits and Systems**
- **Interconnects**
- **Materials, Structures and Devices**
- **Emerging Materials and Devices**



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MARCO/DARPA Interconnect Focus Center (IFC)

- IFC Mission: “To discover and invent new electrical, optical and thermal interconnect solutions that will meet or exceed ITRS projections and enable hyper-integration of heterogeneous components for future terascale systems.”

- Technical Thrusts:

- ◆ Electrical Interconnects
- ◆ Optical Interconnects
- ◆ Thermal Management and Power Delivery
- ◆ Circuit and System Design and Modeling

- Member schools: Stanford, MIT, Cornell, UC Berkeley, RPI, Univ. at Albany, Univ. Central Florida, Carnegie Mellon, NC State, U. Texas, UCSB & GIT
- Georgia Tech is the lead/contracting institution and the IFC operates within the MiRC
- Director - Professor James D. Meindl
- Sponsored by MARCO and DARPA
- Started in 10/1998
- Funding to date \$31.2M (\$7M funding this year)



The Georgia Tech Microelectronics Research Center (MiRC)

PEOPLE: Full time staff of >20 people; >60 faculty users; >200 graduate student users of CR: ~50% ECE, 20% Chem. E., 20% Mech. E. & 10% MS&E, BME, Physics, Chemistry, Biology, GTRI, + 6 start-up companies.

SPACE: >100,000 sq. ft. building; 8,500 sq. ft clean room.

FACILITIES: e-beam lithography, optical lithography, thermal diffusion, oxidation and CVD furnaces, filament & e-beam evaporation, PECVD, RF sputtering, ICP etching, mask making, electroplating, electroless plating, wire bonding, flip-chip bonding etc.

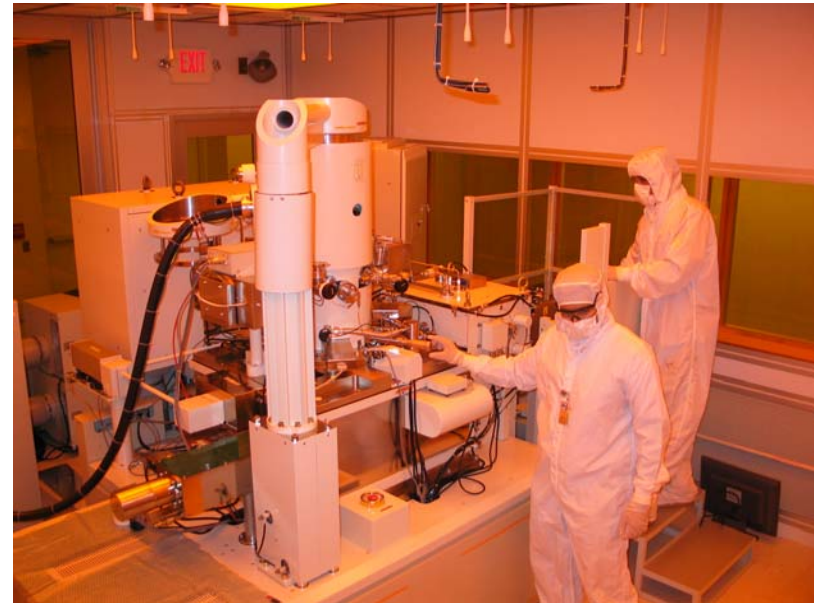
BUDGET: ~\$3.0M/yr.; ~\$30M/yr in faculty PI contracts

MISSION: To provide an unfair advantage



Electron Beam Nanolithography at the Georgia Tech MiRC

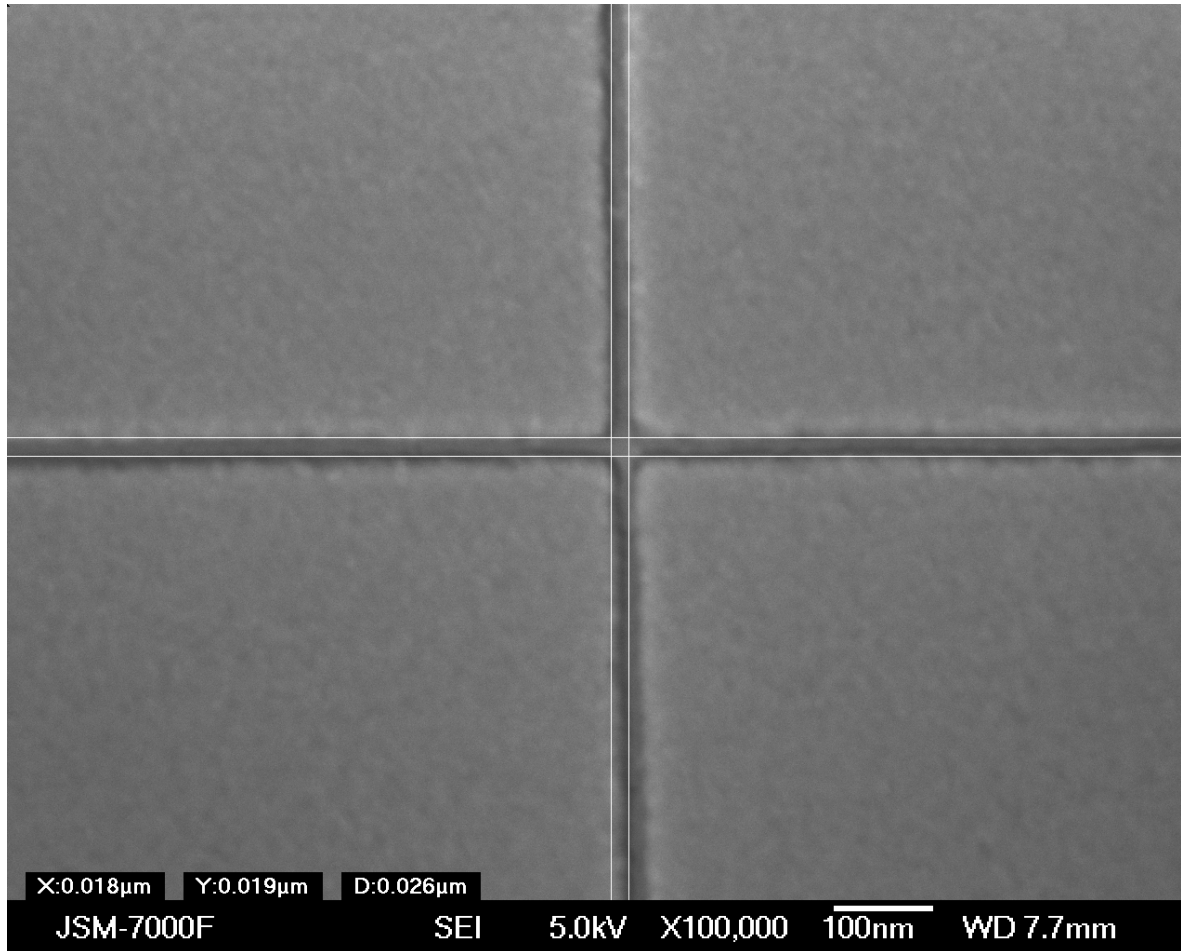
- 100 keV / 4nm spot size JEOL JBX 9300FS electron beam lithography tool
- Supported in part by the Georgia Research Alliance
- Can handle samples from 1 cm² to 300 mm wafers
- Installation is complete
- Located in the 8,500 sq. ft. Microelectronics Research Center (MiRC) cleanroom
- The MiRC Cleanroom Includes:
 - ◆ Wet and dry processing
 - ◆ Thin film deposition and etching
 - ◆ Patterning and Lithography
 - ◆ Process Characterization
 - ◆ Nanostructure Characterization



Specifications

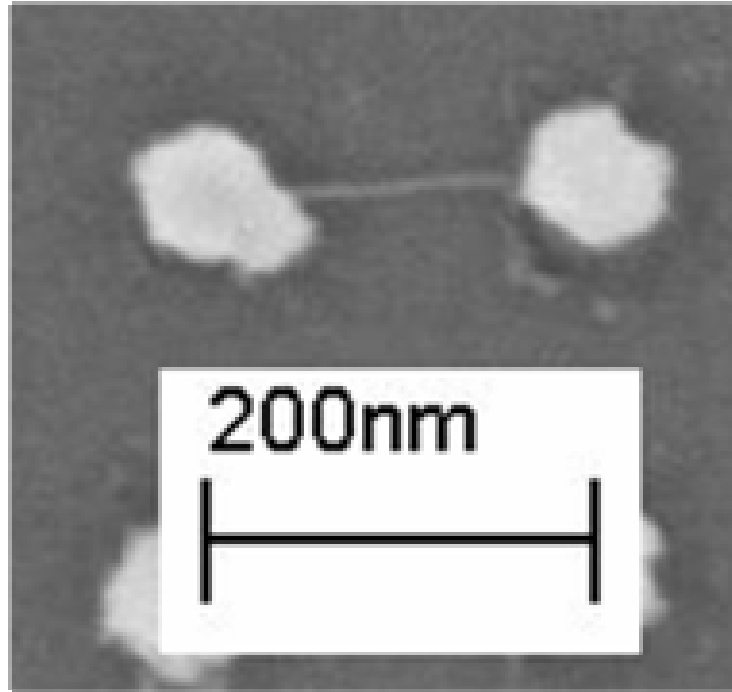
- 4nm diameter Gaussian spot electron beam
- 50kV/100kV accelerating voltage
- 50pA – 100nA current range
- 25MHz scan speed
- ZrO/W thermal field emission source
- vector scan for beam deflection
- 300mm (12") wafers with 9" of writing area
- < 20nm line width writing at 100kV
- < 20nm field stitching accuracy at 100kV
- < 25nm overlay accuracy at 100kV

First Results



18nm line widths – June 1, 2004

Carbon Nanotube Growth



- ~30nm nickel catalyst islands. Nanotube is 4nm in diameter and 125nm long.

Conclusion

Improving Microelectronics/Semiconductor Industry Performance with Academic Research

- Semiconductor Research Corporation (SRC)
- Microelectronics Advanced Research Corporation (MARCO)
- Focus Center Research Program
- Interconnect Focus Center (IFC)
- GIT Microelectronics Research Center (MiRC)
- Electron Beam Nanolithography

