



PIONEERS IN
COLLABORATIVE
RESEARCH®



Research Vectors for AMS Design

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Global Research Collaboration

Semiconductor Research Corporation

Feb. 18, 2011



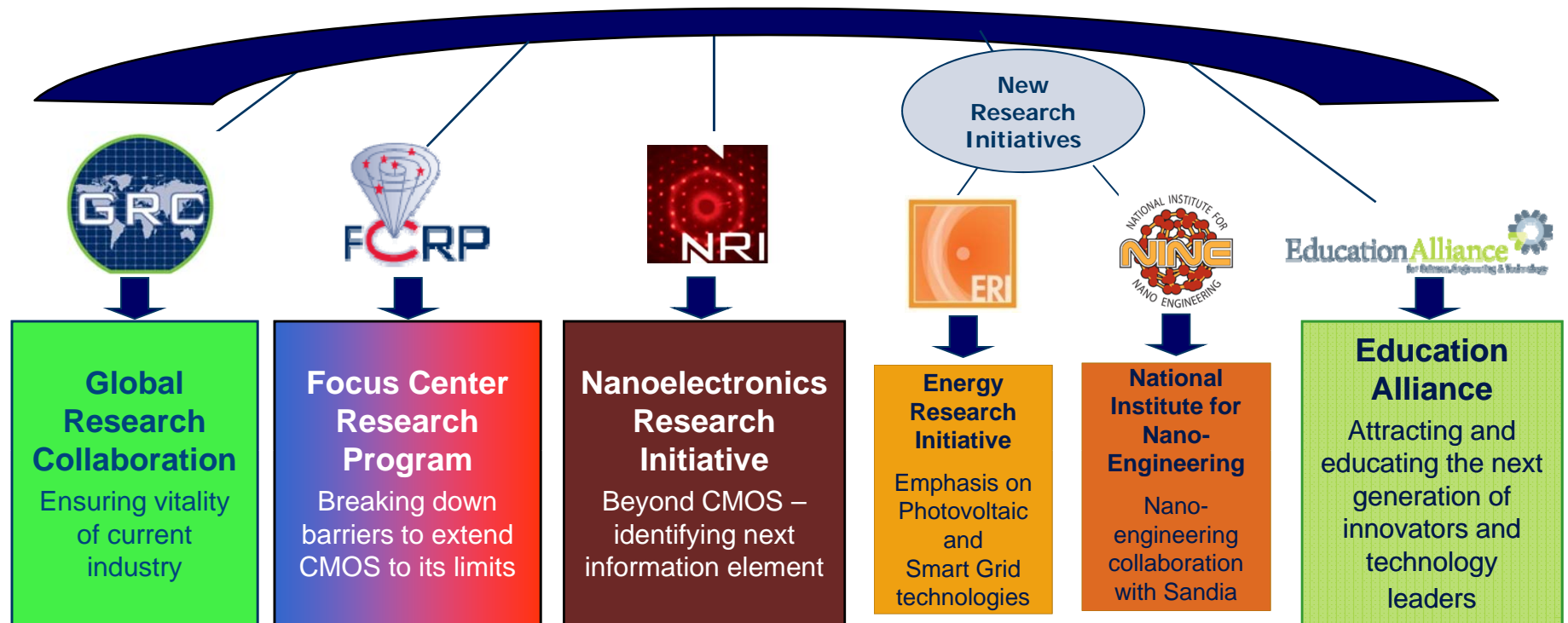
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- SRC overview
 - Solicitation Process and Schedule
 - Sources for Research Directions
 - Research Vectors for AMS Design
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Semiconductor Research Corporation: A Family of Distinct, Related Program Entities



AMD
Freescale
GLOBAL-
FOUNDRIES
IBM
Intel
TI
AMAT
Mentor Graphics
Novellus
TEL
The Mitre Corp

Gov't Participants
State of Arizona
State of Georgia
State of Texas
State of NY
NIST
NSF

Other Participants
SEMATECH
UK Eng & Phy Sci

AMAT
GLOBALFOUNDRIES
IBM
Intel
MICRON
Novellus
Raytheon
TI
United Technologies
Xilinx

Government Participant
DARPA

GLOBAL-
FOUNDRIES
IBM
Intel
MICRON
TI

Gov't Participants
NIST
NSF
State of CA
State of Indiana
State of NY
State of Texas
South Bend, Indiana

Other Participants
Oregon NanoScience &
Microtech Institute

ABB
AMAT
Bosch
First Solar
IBM
Nexans
TEL

Intel
Exxon Mobil
Goodyear

Other Participants
Sandia Laboratories
DOE

Education Alliance
Attracting and educating the next generation of innovators and technology leaders

SRC[®] Current Focus Research Centers



Sponsors



AMD Intel
 Freescale MICRON
 IBM Xilinx
 GLOBALFOUNDRIES
 Texas Instruments



Applied Materials
 Novellus

Dep't of Defense



DARPA

Raytheon
 United Technologies



Multi-Scale Systems Research Center [10 Universities]
Director: Prof. Jan Rabaey (UC-Berkeley). High-level systems design addressing distributed sense and control systems and large-scale and small-scale information technologies systems.



Gigascale Systems Research Center [15 Universities]
Director: Prof. Sharad Malik (Princeton). Platform architectures; concurrent systems programming; platform viability; resilient systems and alternative computation models.



Center for Circuit & Systems Solutions [13 Universities]
Director: Prof. Larry Pileggi (CMU). Circuit/module infrastructure; enterprise systems; portable electronics; functional diversity and emerging circuits for post CMOS.



Interconnect Focus Center [13 Universities]
Director: Prof. Paul Kohl (Georgia Tech). Nanoscale electrical & optical interconnects; energy delivery and thermal management; wireless connectivity; modeling, analysis and assessment of new connectivity solutions.



Materials, Structures and Devices [15 Universities]
Director: Prof. Dimitri Antoniadis (MIT). Integration of new materials enabling CMOS extension; carbon-based devices; novel embedded memory; functional diversification; theory, modeling and simulation of new devices.



Functional Engineered Nano-Architectonics [14 Univ.]
Director: Prof. Kang Wang (UCLA). Novel materials and processes which enable fabrication of nanoscale devices and interconnects.

UC Berkeley - Lead

Caltech	U. Michigan
NC State	UCSD
Rice	USC
Stanford	UIUC
U. Maryland	

Princeton - Lead

CMU	U. Michigan
Columbia	U. Penn.
GaTech	UCB
Harvard	UCLA
MIT	UCSD
Stanford	UCSB
U. Mass.	UIUC

Carnegie Mellon-Lead

Caltech	U. Michigan
Columbia	UCB
Cornell	UCLA
MIT	UCSD
Stanford	UIUC
Texas A&M	UT Dallas

Georgia Tech - Lead

Arizona State	Stanford
Caltech	SUNY Albany
Columbia	U. Florida
Dartmouth	UCB
MIT	UC Riverside
Rensselaer	UCSC

MIT - Lead

Columbia	U. Mass.
Cornell	U. Penn.
Harvard	UCB
Penn State	UCSD
Purdue	UIUC
Stanford	UT Austin
SUNY Albany	UT Dallas

UCLA - Lead

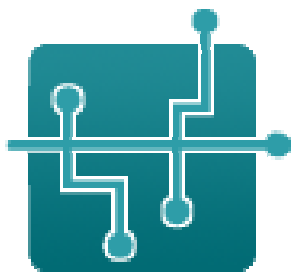
Caltech	U. Mass.
Columbia	UCB
MIT	UC Riverside
NC State	UCSB
Northwestern	UCS
Purdue	Yale
Stanford	



SRC GRC Research Program Structure

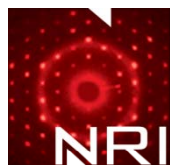


- **CADTS - Computer-Aided Design and Test Sciences**
 - Logic and Physical Design
 - Test and Testability
 - Design Verification
- **ICSS - Integrated Circuit and System Sciences**
 - Integrated Systems Design
 - Circuit Design (including TxACE)
- **DS - Device Sciences**
 - Digital CMOS
 - Non-Classical CMOS
 - Memory Technologies
 - Modeling and Simulation
 - Compact Modeling
 - Analog and Mixed-Signal
- **NMS - Nanomanufacturing Sciences**
 - Nano-Engineered Materials
 - Patterning
 - Metrology
 - ESH
- **IPS - Interconnect and Packaging Sciences**
 - Packaging
 - Back-End Processes
- **CSR - Cross-Disciplinary Semiconductor Research**
 - Small, very forward looking, one year research grants
 - Special projects



Technology and Talent for the 21st Century

Mark your
calendar now!



TECHCON 2011

Renaissance Hotel
Austin, TX

September 12 & 13, 2011

Showcasing:

- The quality of the research portfolio
- The excellence of SRC students and faculty
- The magnitude of the collaborative research investment made by the semiconductor industry through SRC

SRC's thirteenth premier technical conference
complete information at www.src.org

*global research collaboration, focus center research program and
nanoelectronics research initiative are program entities of
semiconductor research corporation*





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■ Selection of Research

- Member-driven creation of "[Research Needs Document](#)"
- Solicitation and submission of white papers
- Member review and selection of white papers
- Request for full proposals
- Member review and selection of proposals to fund

■ Program Management

- Three-year contracts
- Annual member reviews of progress with feedback
- Member involvement via the Industrial Liaison Program
- Dissemination of reports and "deliverables" to members
- Technology transfer by faculty/student visits and e-Workshops



2011 GRC Funding Opportunities



The screenshot shows the SRC website homepage. At the top is the SRC logo and the text "Semiconductor Research Corporation" and "Pioneers in Collaborative Research®". A search bar is on the right. Below is a navigation menu with links: Home, My SRC, Programs, Student Center, Calendar, Library, Newsroom, and About. The main banner features a photo of two men in a meeting and the text: "We were founded on a radically simple premise — that collaborative university research, sponsored by industry rivals, would raise the competitiveness of all participants. The experiment has succeeded beyond our imagination." A "LEARN MORE" button is present. Below the banner are three columns of content:

- Our Research Programs:**
 - GRC** Global Research Collaboration
 - FCRP** Focus Center Research Program
 - NRI** Nanoelectronics Research Initiative
- NEWS & PRESS RELEASES:**
 - Feb 02, 2011: **NOTICE: SRC website to be offline for server maintenance**. Routine web server maintenance between 10 AM Saturday February 12 and 8 AM Sunday Feb 13. » [Read More](#)
 - Jan 17, 2011: **TECHCON 2011 - Call for Abstracts**. The TECHCON 2011 call for abstracts is now open. Deadline is February 22 at 3:00 p.m. ET. » [Read More](#)
 - Jan 24, 2011: **SRC and Stanford Develop Unique Combination of Elements for**
 - Jan 11, 2011: **Potential opportunities for nanotechnology in electronics**
- RESEARCH FUNDING OPPORTUNITIES:** SRC funnels millions of dollars to research teams at universities worldwide. Visit our [research funding opportunities](#) page for up-to-date descriptions of research needs, solicitation schedules, and information on how you can join the SRC research community.
- EDUCATION ALLIANCE:** A private foundation, the **Education Alliance** is committed to



2011 GRC Funding Opportunities



GRC Funding Opportunities

There are no open calls at this time.

Anticipated Calls for GRC White Papers

- Device Sciences (DS) - Memory Technologies - Open May 2011
- Computer-Aided Design and Test Sciences (CADTS) - Logic and Physical Design - Open May 2011
- Nanomanufacturing Sciences (NMS) - Environment, Safety & Health - Open March 2011
- Device Sciences (DS) - Modeling & Simulation - Open July 2011
- Computer-Aided Design and Test Sciences (CADTS) - Verification - Open August 2011
- Device Sciences (DS) - Compact Modeling - Open June 2012

Archived Calls for white papers

→ (with links to past Needs Documents)



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GRC ETAB Priorities 2010



- Scaling to Ultimate CMOS: Processes, Materials, Devices, Packages, and Systems
- Analog/Mixed Signal: Processes, Materials, Devices, Packages, and Systems
- Memories: Materials, Devices, Circuits, and Subsystems
- Low Power Architecting: Devices, Circuits, and Systems
- Power, Thermal, and Energy Management
- Design Productivity for Circuits and Systems
- Application-specific Integration of Diverse Technologies
- 3D IC Architecting: Technology, Design, Test, and CAD
- Multicore Homogeneous/Heterogeneous Systems
- Reliable, Resilient and Robust Technology, Circuits, and Systems
- ESH Stewardship for Materials, Processes and Energy



■ Silicon Complexity

- Non-ideal scaling of device parasitics and supply/threshold voltages
- Coupled high-frequency devices and interconnects
- Manufacturing variability
- Complexity of manufacturing handoff
- Scaling of global interconnect performance relative to device performance
- Decreased reliability

■ System Complexity

- Reuse
- Verification and Test
- Cost-driven Design Optimization
- Embedded Software design
- Reliable Implementation Platforms
- Design Process Management

■ Cross-cutting challenges

- Design Productivity; Power Management; Design for Manufacturability; Interference; Reliability

■ Expansion of analog in revision of RF/Wireless Chapter

- Revision of RF/Wireless chapter
- mm-wave; Power management; Short-distance transceivers/transducers; High speed links (40 Gbps) ; Automotive controls;





ICSS Environment and Trends (1)



- Technology-driven constraints and increased transistor count impact all circuits and systems
 - Process variability, leakage, low-V_{dd}, new devices (eg. FinFETs)
 - Increased probability of reliability-induced failure: SEU/aging
 - Resilient circuits and architectures will be essential
 - Design complexity increases faster than transistor count
 - POWER will always be an issue – even beyond CMOS
- Design research on the CMOS scaling path continues
 - Adaptive systems: reconfigurable, self-adaptation, self-test
- High fab cost and restricted access constrains research outcome
 - Need is to focus on areas where universities add value
 - Critical to address above trends



ICSS Environment and Trends (2)



- Emphasis on multi-core, 3D, SoC/SiP: integration and reliability
 - Software concurrency, tools, debug, verification, programming model
- Integration of multiple functional blocks + software
 - Long and difficult new product development and launch cycles, including software development and debug
 - Challenging to optimize digital and analog circuits...
- Diverse applications drive architecture/ IP/circuits/ software
 - Design constraints cover power, performance, cost, safety
- The spectrum of research is broad and interdisciplinary
 - Digital, analog, mixed-signal, RF, memory & I/O
 - Novel structures: multi-gate, 3D integration, devices
 - Reliability impact: cause-effect and solutions
 - Covers frequencies of interest from Hz to hundreds of GHz
 - Sensors, actuators, cyber-physical systems



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Research Vectors for AMS Design



- Scalable Analog Design
- Mm-wave Design Infrastructure
- Reliability
- Power Conversion
- 3D



- Scalable Analog Design
 - Models for advanced processes
 - Robust circuits (process and operating environment)
 - CAD and test
 - Design portability across nodes
- Mm-wave Design Infrastructure
 - Models and simulation for active/passive components
 - Circuit building blocks and topologies unique for frequency range
 - Test



- Reliability
 - Test and verification
 - ESD
- System Power Management
 - Low power design
 - Power monitoring and management
 - Thermal management
 - High performance, low energy I/Os
- 3D
 - Modeling and development of interconnect structures
 - Reliability and power management



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- SRC welcomes participation by CDADIC faculty
 - Opportunities for collaboration abound
 - Many research topics -- spanning many applications
 - Some described here, some not



Thank you!