NIST Working with Industry via the Rapid Innovation and Competitiveness (RIC) Initiative

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The Rapid Innovation and Competitiveness (RIC) Initiative

A new public-private partnership for R&D investment

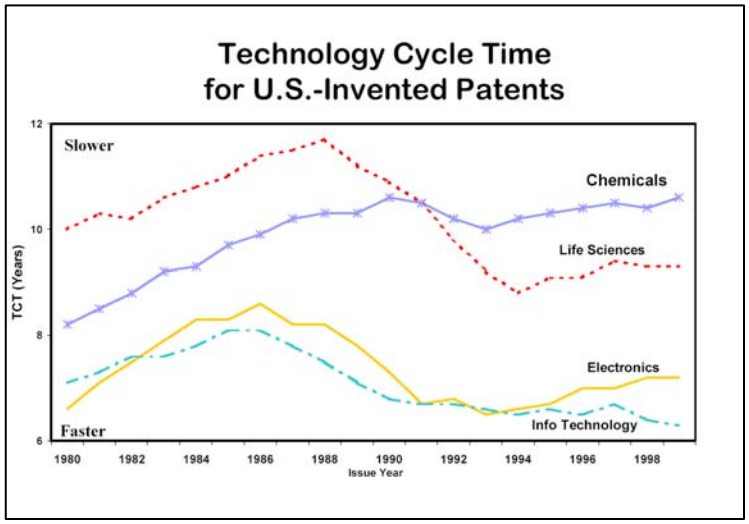
Goals:

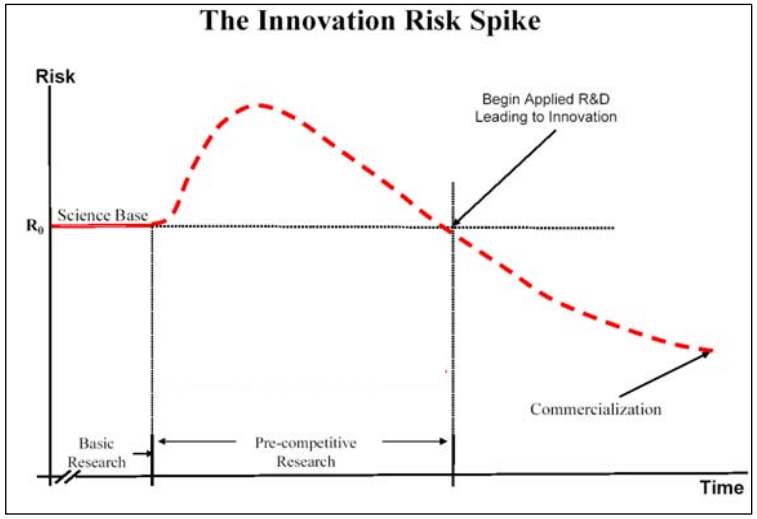
- Increase the Nation's return on its scientific investment
- Collapse the timescale of technological innovation

Approach:

- Coordination and Advanced Planning
  - Partners from industry, academia, and government develop a shared vision of an industry sector's research needs via a technology roadmap
- Research and Knowledge Transfer
  - Fund directed basic research, measurement science research, and standards development based on the needs and priorities of the roadmap
  - Periodically re-evaluate the impact and priority of that research
  - Sponsor postdoctoral fellowships and personnel exchanges to facilitate tacit knowledge transfer
- Transition scientific findings to commercial products
  - Provide a framework that facilitates regional government and venture-capital support, enabling a clear path to commercialization

Key Obstacles to Innovation

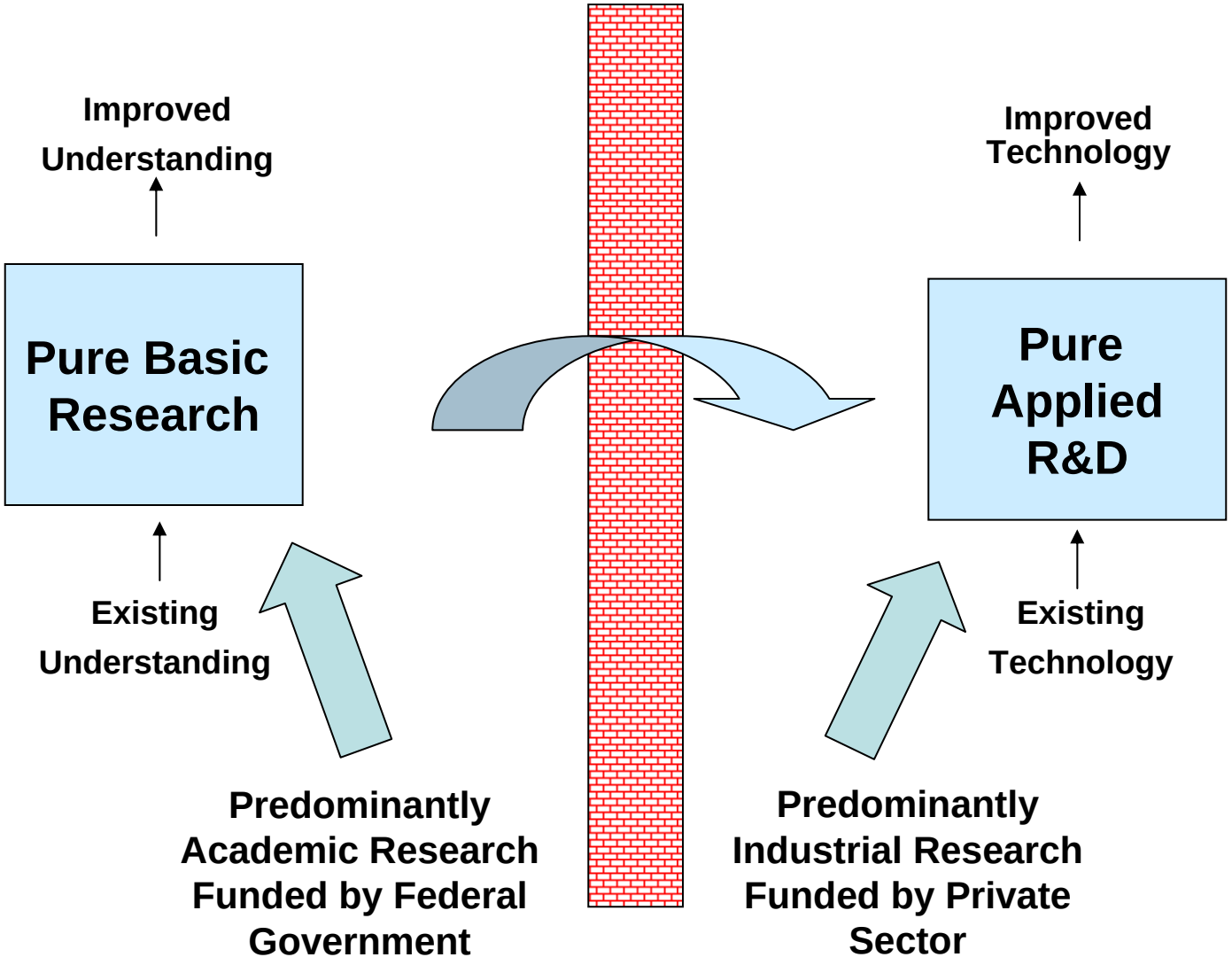




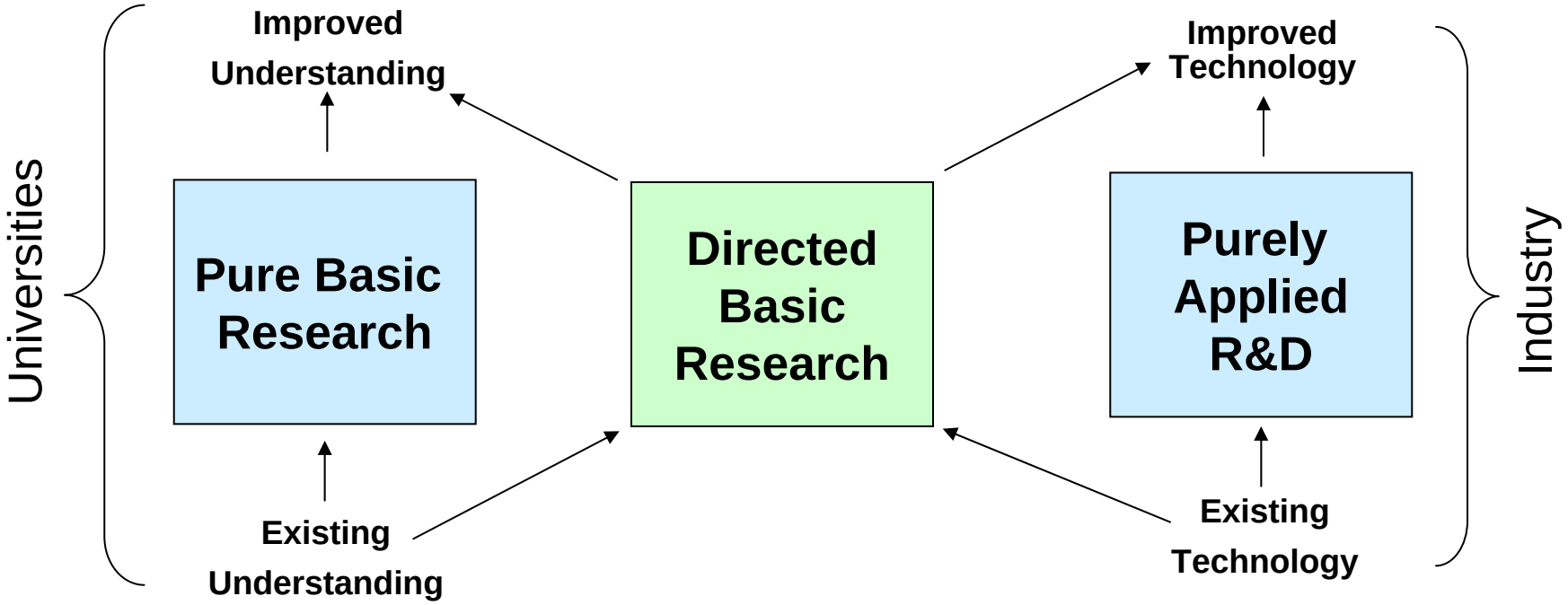
- The time it takes to transform knowledge from the bench into a feasible product, and the risk inherent in that process

- Contributing Factors:
  - Lack of end-to-end planning from basic science to commercialization
    - The criteria for funding basic research are often divorced from the needs of industry
  - Increasing complexity of many critical technologies, requiring a multidisciplinary approach
  - Need for technical hurdles to be identified and addressed early

Current R&D Paradigm



Creating a New Paradigm by Connecting Basic Science with Economic Drivers



Goals: Shared vision; leveraging unique strengths; inclusive; efficient knowledge transfer; high impact

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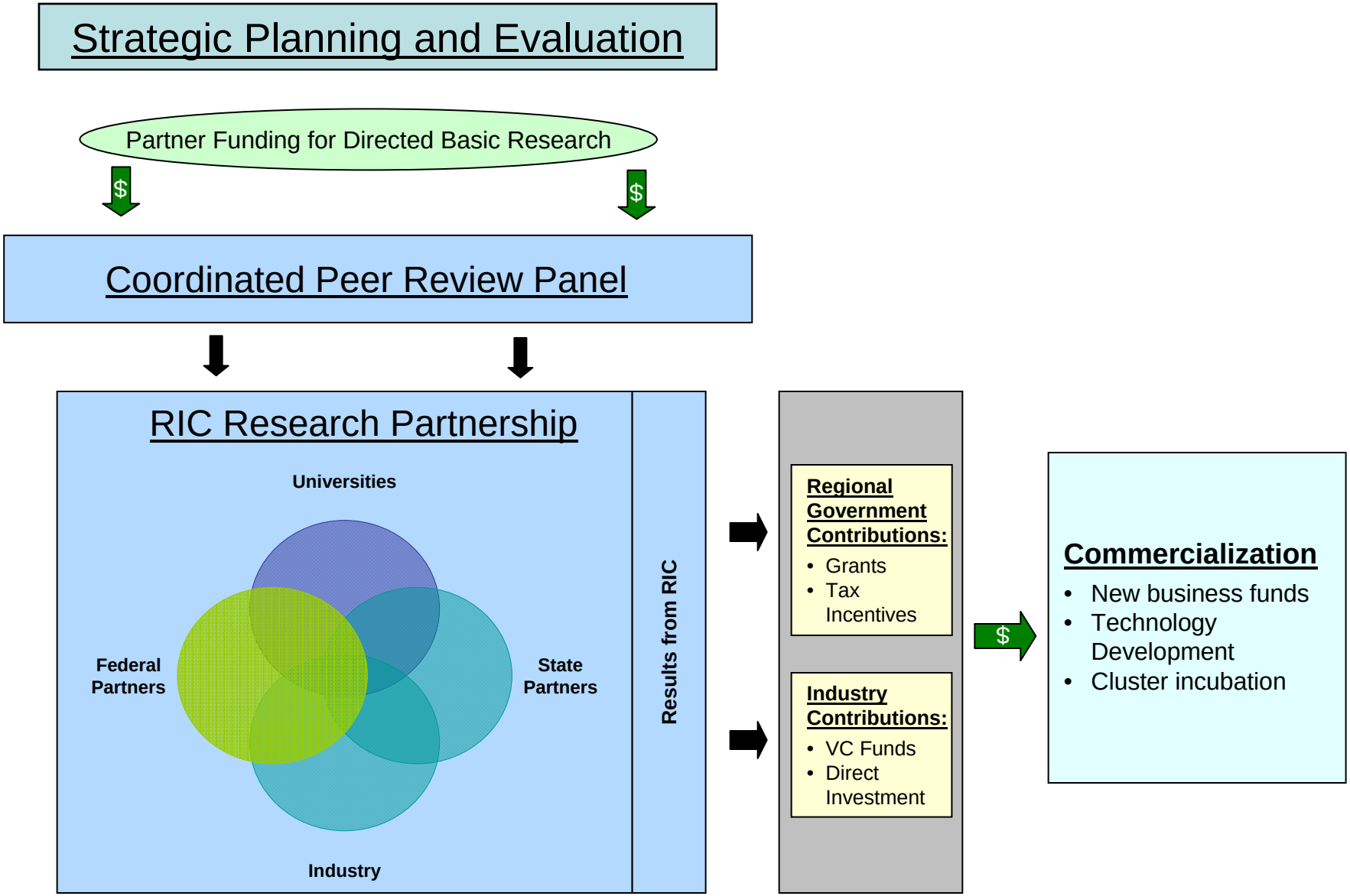
The RIC: Putting it All Together



Pilot Program with Nanoelectronics Research Initiative (NRI) Initiated in 2007

- For pilot, NIST sought public-private partnerships to accelerate the support of research and innovation in nanoelectronics, an emerging area that exploits unique properties of nanometer-scale materials
- Competition announced in Federal Register May 4, 2007
- NIST/NRI partnership announced September 13, 2007
  - The NRI is a collaborative effort between industry, government, and academia to support world-class research in nanoelectronics.
  - NRI is part of the Semiconductor Research Corporation (SRC), which is part of the Semiconductor Industry Association (SIA)
  - NRI goal: Demonstrate novel yet practical computing devices capable of replacing conventional chip technology by 2020
- Cooperative agreement, renewable for up to five years
- NIST provides $2.76 million per year; six NRI partners match with at least 25% each
- Funds combined and competitively awarded for research at U.S. universities to meet industry's long term needs
- NIST has requested an additional $1.5 million in its FY 2009 budget request for related in-house research

NIST

NRI anoelectronics RESEARCH INITIATIVE

SRC®

NRI Funding

AMD freescale semiconductor IBM intel Texas Instruments Micron

Strategic Planning and Evaluation

ITRS

International Technology Roadmap for Semiconductors

POST-CMOS: NRI Defined 13 Research Vectors of primary importance for finding the next switch

$2.75M per year NIST

$5M per year Industry Partners

$15M per year States

$110M / over 5 years States & Private

University-Based Research

- **INDEX: Institute for Nanolectronics Discovery and Exploration**
- **MIND: Midwest Institute for Nanoelectronics Discovery**
- **SWAN: South West Academy of Nanoelectronics**
- **WIN: Western Institute of Nanoelectronics**

Research Results

Business Start-up, Development, and Commercialization

Regional Government Contributions:
- Grants
- Tax Incentives

Industry Contributions
- VC Funds
- Direct Investment

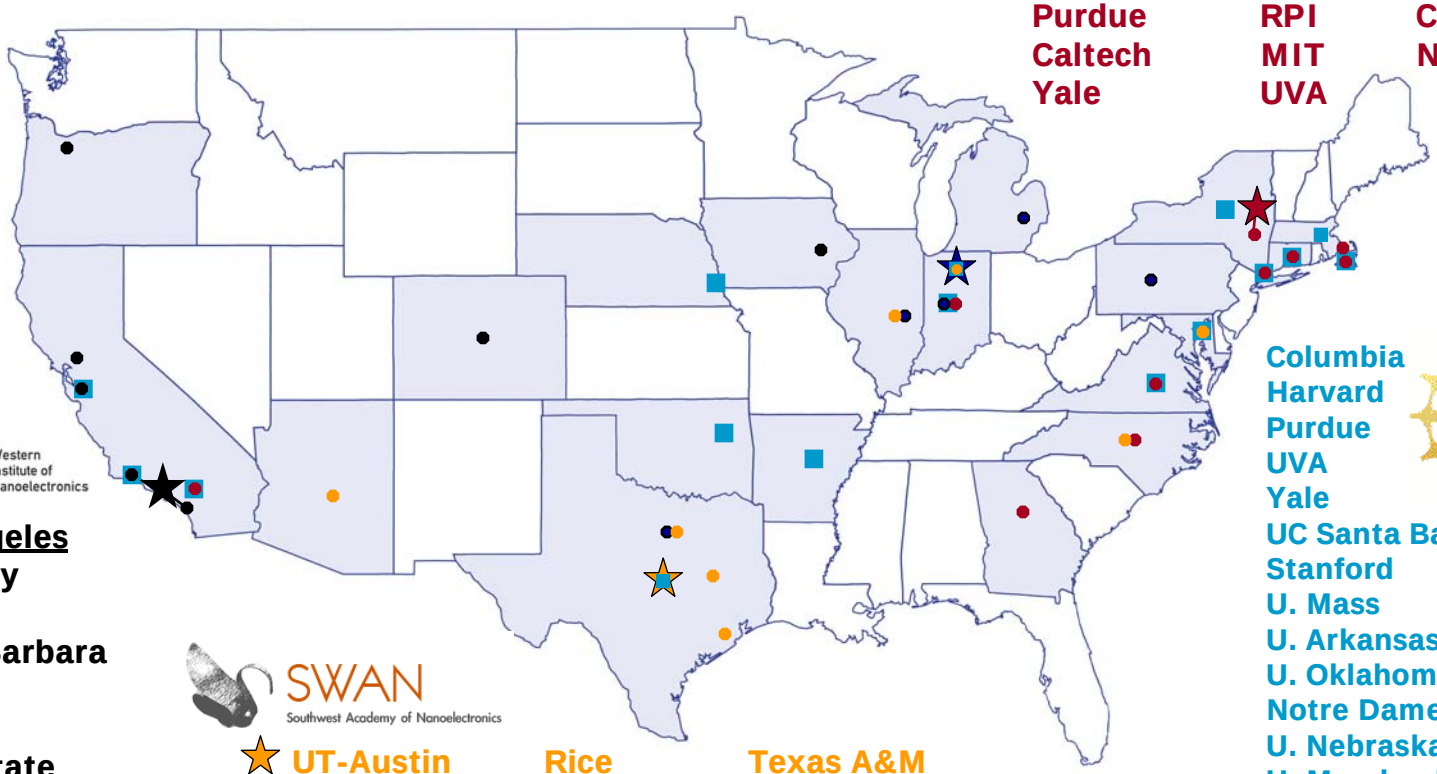
4 Centers, 35 Universities, 20 States

Nanoelectronics • Architectures MIND
MIDWEST INSTITUTE FOR NANOELECTRONICS DISCOVERY

★ **Notre Dame**
Illinois-UC
Michigan
Purdue
Penn State
UT-Dallas

INDEX
INSTITUTE FOR NANOELECTRONICS DISCOVERY AND EXPLORATION

★ **SUNY-Albany**
Purdue
Caltech
Yale
GIT
RPI
MIT
UVA
Harvard
Columbia
NCSU



WIN Western Institute of Nanoelectronics

★ **UC Los Angeles**
UC Berkeley
UC Irvine
UC Santa Barbara
Stanford
U Denver
Portland State
U Iowa

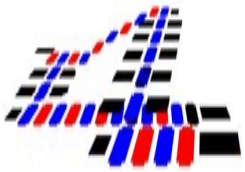
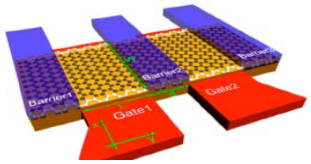
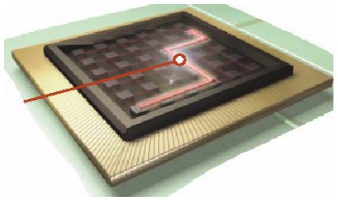
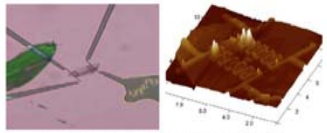
SWAN Southwest Academy of Nanoelectronics

★ **UT-Austin**
UT-Dallas
U. Maryland
Rice
ASU
NCSU
Texas A&M
Notre Dame
Illinois UC

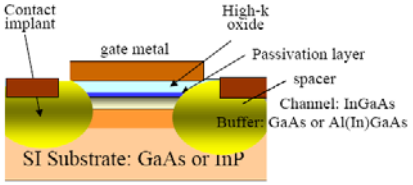
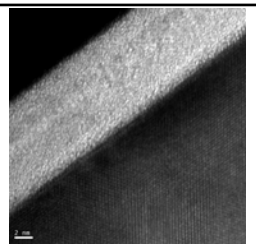
NSF

Columbia
Harvard
Purdue
UVA
Yale
UC Santa Barbara
Stanford
U. Mass
U. Arkansas
U. Oklahoma
Notre Dame
U. Nebraska/Lincoln
U. Maryland
Cornell
UT Austin
Caltech

NRI Research Centers and Collaborations

NRI Center	WIN Western Institute of Nanoelectronics	INDEX INSTITUTE FOR NANOELECTRONICS DISCOVERY AND EXPLORATION	SWAN Southwest Academy of Nanoelectronics	Nanoelectronics • Architectures MIND MIDWEST INSTITUTE FOR NANOELECTRONICS DISCOVERY
Sample General Project	**Spintronics**	**Post-CMOS Switches**	**Novel structures and architecture**	**Energy-Efficient Devices**
Sample Individual Project	Magnetic Dot Logic 	**Graphene-based Quantum Devices** 	 **NanoPlasmonics**	**Thermal Transport and Thermal Logic Gates** *Chen et al.* Purdue and NML  Patterned graphene nanostructures

Credits (left to right): J. Bokor/Berkeley et al.; C. Marcus/Harvard et al.; Y. Massoud, Rice et al.; Chen et al., Purdue/NML

NIST-Georgia Tech Measurements of electrical conductivity in graphene	
NIST/Notre Dame and NIST/UT-Dallas Characterizing the interface between III-V substrates and gate electrode in next generation high-mobility transistors	 

Credits (left to right): Rutter et al., Georgia Tech/NIST; UT-Austin

Industry Support of NIST's Involvement

- "NIST joining NRI not only enabled the recent expansion of the program, but also was instrumental to convincing the NRI industry members to extend their commitments for funding the program beyond 2008, so this partnership has already resulted in increased support for the program."

  -- Jeffrey Welser, Director of the Nanoelectronics Research Initiative:

- "There is tremendous interest in every part of the world to win the nanoelectronics race and reap the economic rewards that will go with it. For America to win, it will take radical collaboration between government, higher education and industry. The best example of this type of collaboration is the important work going on in the Nanoelectronics Research Initiative at more than 30 universities with funding and participation from NIST, IBM and other major semiconductor and research institutions."

  -- John E. Kelly III, IBM Senior Vice President and Director of Research

- "The research results from this new initiative will enable the semiconductor industry to extend Moore's Law -- the 40-year-old prediction that the industry can double the amount of transistors it places on a computer chip every couple of years -- far beyond the year 2020 when the potential limits of the current industry technology may be approached."

  -- Larry Sumney, President and CEO of the Semiconductor Research Corporation

- "The Nanoelectronics Research Initiative (NRI) and the regional research centers exemplify what can be done when industry, government and academia work together. This investment is likely to pay substantial dividends in the future. Leading-edge university research centers have proved to be powerful magnets for investment by technology companies and will help build the high-tech ecosystem for high-value jobs in the future."

  -- George Scalise, President of the Semiconductor Industry Association

RIC Initiative

An Enhanced Model for Enabling U.S. Innovation

- *Connects academic capabilities with industrial needs*
  - Taps into multi-disciplinary expertise broader than scope of a typical company
- *Stimulates investment in higher risk but potentially higher payoff research*
  - Embodies shared risk model of investments
  - Leverages positive research “economy of scale” (serendipity and dual use)
- *Increases the rate-of-return on the Nation’s investment in the basic science enterprise*
  - Creates directed basic research that is prioritized and evaluated in partnership with the private sector
- *Increases private and state investment in seed technologies*
  - Lowers scientific risk by virtue of NIST involvement
  - Lowers business risk by connecting technology development with Industry roadmaps
- *Shortens time between discovery and commercialization*
  - Enables sustainable technology leadership and continual product innovation
  - Creates global 1st mover advantage for U.S. Industry
- *Provides multiple benefits to NIST core*

RIC Benefits to NIST Core

- Identifies key areas for NIST growth
- Maximizes the return on NIST measurement science and standards investments
  - By identifying and addressing the highest impact measurement science and standards needs
  - By accelerating technology transfer to stakeholders
  - By enhancing skills transfers through personnel exchanges
- Stimulates increased NIST-industry and NIST-university collaborations
- Increases the visibility of and stakeholder support for NIST core
- Justifies increases in NIST funding for measurement science and standards research focused on high impact industry needs
  - Through new budget initiatives
  - Through reallocations of existing funding
- Promotes increased levels of stable external funding for critical breakthrough measurement science and standards research