### Nanotechnology Signature Initiative*

Nanoelectronics for 2020 and Beyond

**Overview**

The semiconductor industry is a key driver for U.S. and global economic growth and has contributed significantly to the productivity gains experienced over the past several decades. These gains are due, in part, to the continuous miniaturization enabled by advances in materials science, microelectronics design and fabrication, and manufacturing. As length scales of electronic devices approach atomic dimensions, current architectures are reaching physical limits, and new methods for storing and manipulating information must be developed for miniaturization to continue. Further reductions in device dimensions are important to increase processing speed, reduce device switching energy, increase system functionality, and reduce manufacturing cost per bit.

**Goals**

To accelerate the discovery and use of novel nanoscale fabrication processes and innovative concepts to produce revolutionary materials, devices, systems, and architectures to advance the field of nanoelectronics.

**Thrust Areas**

- Exploring new or alternative “state variables” for computing
- Merging nanophotonics with nanoelectronics
- Exploring carbon-based nanoelectronics
- Exploiting nanoscale processes and phenomena for quantum information science
- Expanding the national nanoelectronics research and manufacturing infrastructure network

**Agencies Involved**

Department of Commerce (National Institute of Standards and Technology), Department of Defense, Department of Energy, Intelligence Community, National Aeronautics and Space Administration, and National Science Foundation.

**Examples of Activities that Support the Goals of the Nanoelectronics NSI**

**Carbon-based Nanoelectronics**

![Graphene Drumheads](image)

NIST Graphene Team – Electromechanical Properties of Graphene Drumheads

Credit: N. Klimov and T. Li, NIST/UMD

**Carbon-based Nanoelectronics**

NIST researchers showed that straining a graphene membrane creates pseudomagnetic fields that confine the graphene’s electrons and create quantized quantum dot-like energy levels. Credit: N. Klimov and T. Li, NIST/UMD

**Merging nanophotonics with nanoelectronics**

Brongersma group, Stanford

**New State Variables for Computation**

Credit: Courtesy SRC-NRI. A. Yacoby, South West Academy of Nanoengineering (SWAN).

**Scribe Line Test Structures for Intel CPUs**

Image courtesy of the Optical Microscopy team at the National High Magnetic Field Laboratory at FSU.

**Examples of Activities that Support the Goals of the Nanoelectronics NSI**

First CMOS compatible Ge laser diode (MIT)

For more information, contact the National Nanotechnology Coordination Office (NNCO) at info@nnco.nano.gov

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*Nanotechnology Signature Initiatives (NSIs) are topical areas identified by the National Nanotechnology Initiative and its agencies as benefiting greatly from close and targeted interagency interactions. The NSIs spotlight key areas of national priority and provide a mechanism for enhanced collaboration to leverage research and development programs across multiple agencies.*