NSF Nano-scale Science and Engineering Center for Scalable and Integrated NanoManufacturing (NSEC SINAM, CMMI-0751621)

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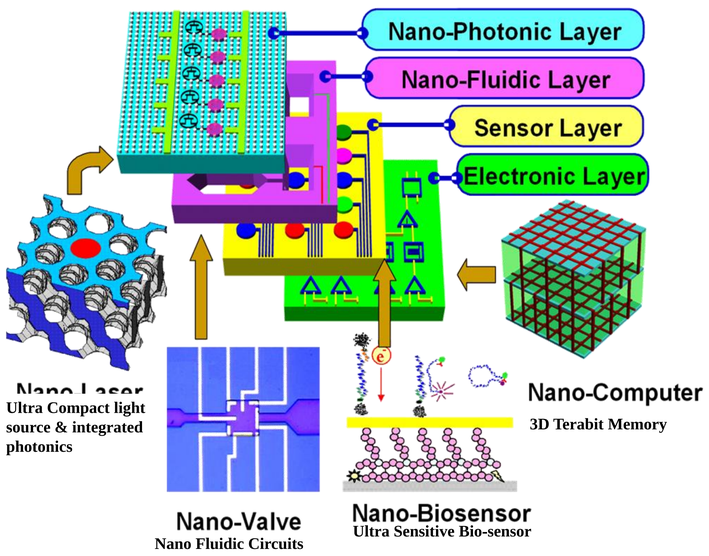
Research Vision

Vision: Develop a nano-manufacturing paradigm to provide the quantum leap from lab science to industrial revolution.

SINAM's goal is to establish a nano-manufacturing paradigm of new technologies that tackle critical challenges: 2D features below 20 nm; high dimensional fabrication and heterogeneous integration of multiple functionalities.



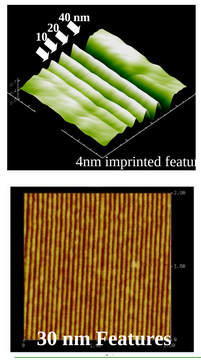
Integrated Research Groups: An innovative concurrent systems engineering approach, tackles these grand challenges aimed at issues of scalability, productivity and efficiency.

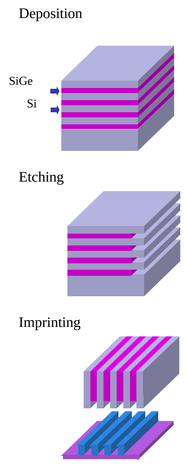
A nano-manufacturing paradigm will greatly impact human society as did the industrial and technological revolutions. SINAM embraces the responsibility to educate, assess environmental impact and create business.

Top-Down Nano-Manufacturing

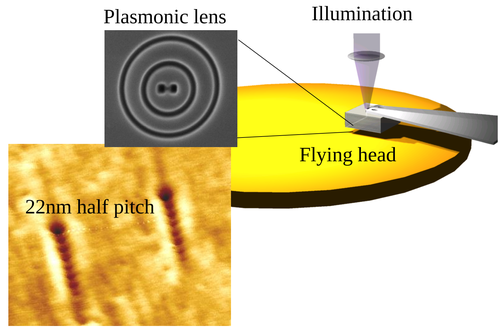
Top-down nano-manufacturing approach aimed at developing and discovering techniques for nano-fabrication in the 1–50 nm range.

Nano Imprint Lithography: 1-20 nm molds for 2D applications.

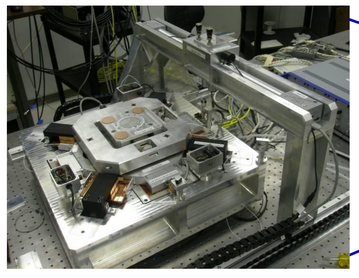


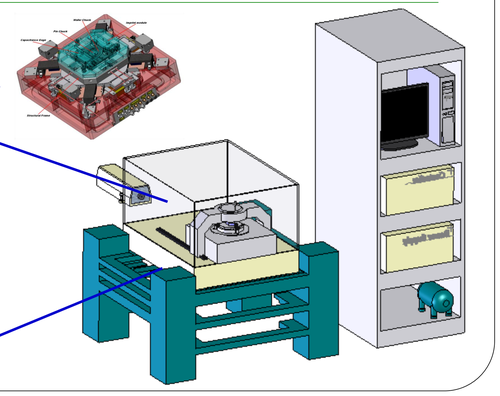


Adapt hard disk technology for mask-less plasmonic nano lithography (PNL). Here, 80 nm features were created using PNL system scanned at 10 m/s.



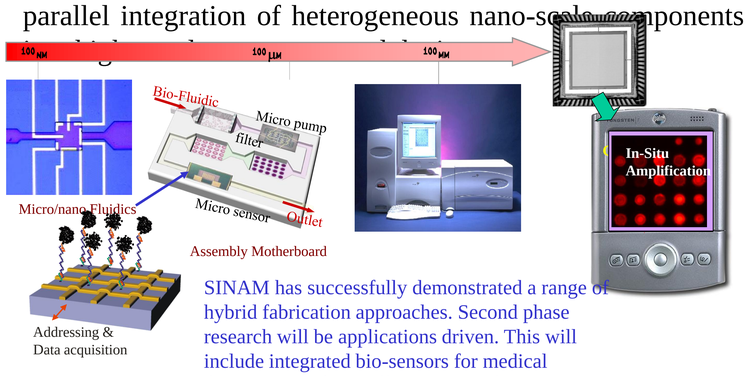
A nano-precision Multi-scale Alignment and Positioning System (MAPS) is the test-bed for scalable plasmonic lithography and nano imprinting.





Hybrid Nano-Manufacturing

Hybrid top-down and bottom-up technologies for massively parallel integration of heterogeneous nano-scale components

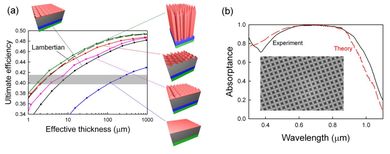


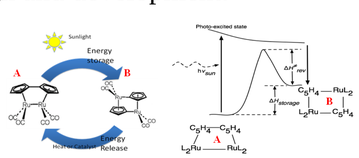
SINAM has successfully demonstrated a range of hybrid fabrication approaches. Second phase research will be applications driven. This will include integrated bio-sensors for medical diagnostics, a $1.5 Billion/year market.

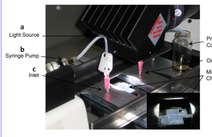
New Energy Systems Engineering

New energy systems engineering strategies to scale up the technologies in with product design and development.

Efficient light-trapping is extremely important to reduce the cost of crystalline silicon solar cells by decreasing the silicon mass while increasing the device efficiency. SINAM researcher found that systematic symmetry breaking of periodic nanostructures achieves an absorptance that closely follows the Lambertian limit for isotropic incident radiation.





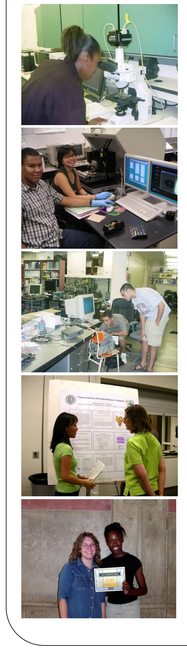


New organo-metallic compounds. It is another novel way to convert solar energy into chemical form for storage and transportation.

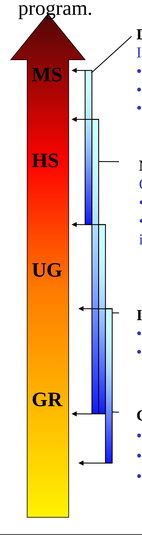
Environment

The impact of nanotechnology on the environment is a hot topic, both politically and scientifically. SINAM works toward a new design paradigm where energy consumption and external impacts are built into the design process. In accordance with this philosophy, efforts to characterize efficiency and environmental impacts of nano-manufacturing are paramount. Nano-scale devices have the potential to provide energy savings in certain phases of their life-cycle. However greater cost, in terms of energy, is a major trade-off with the increased precision in manufacturing. Understanding the expenditure of energy during the manufacturing phase is crucial to ensuring energy savings over a products entire life cycle. In addition, studies of environmental and social impact, manufacturing capabilities, materials use, and human and ecological toxicity are being investigated to realize a truly new paradigm in manufacturing design.

Education, Society and Ethics



SINAM's educational programs span all education levels and include initiatives for under-represented communities, 7th-12th grade programs, undergraduate summer academy and graduate young investigator program.



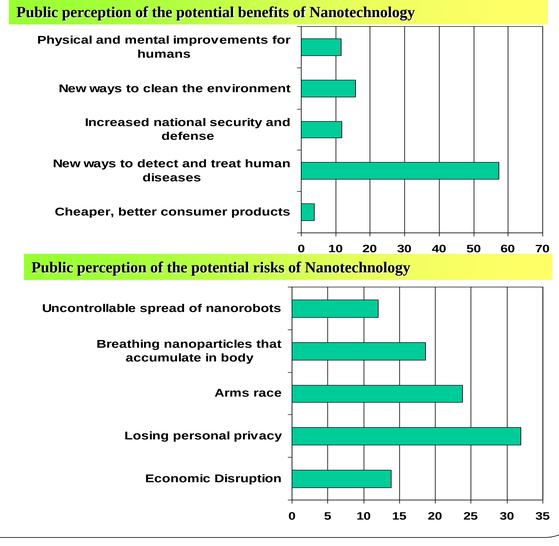
Discover Nanotechnology (Grades 7-12)
Inquiry based modules
- See and feel the Nano-world
- Graduate teaching fellowships.
- Piloted in Los Angeles and Oakland

Nano-Manufacturing Summer Academy/REU
Connecting to research
- High school students, teachers, undergrads
- Short courses, lab experience, competitions, internships

Interdisciplinary Curricula
- Undergrad.: Nano-Mfg. design projects
- Graduate: SINAM research based modules

Graduate Young Investigator (GYI)
- SINAM graduate student competition
- GYI brings 2+ faculty from different disciplines
- Funding for innovative research project

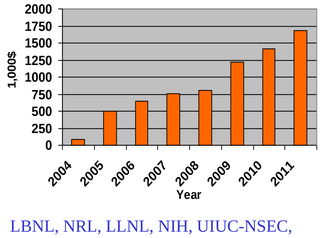
SINAM is responsible for gathering and disseminating the facts of nanotechnology's potential impact on society. SINAM has liaised with the RAND corporation to study the current societal impact of Nano-manufacturing.



Economic

SINAM attracts industrial partnerships through progressive research programs and collaboration initiatives. The Industrial Affiliates Program with a new standardized IP agreement helps to rapidly integrate new partners.

Spin-off companies currently operate as a result of SINAM research. *NanoLithoSolutions* produces inexpensive nano imprint lithography tools. *Synilixir Therapeutics* applied system optimization schemes to search for combination drugs. Kalinex Inc. is developing technology to emulate the sense of smell, which is the only human/animal sense that has not yet been replicated in small devices and systems. Nano-CAD developed by SINAM has helped several start-ups.



LBNL, NRL, LLNL, NIH, UIUC-NSEC, CNSI, CITRIS, and International Collaborators