

Welcome to NACK's Webinar

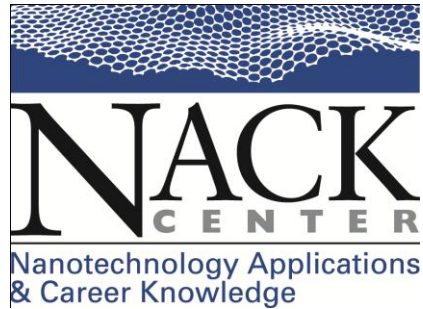
Nanotechnology Applications in Today's World

NACK is an NSF-funded ATE Resource Center Supporting
Nanotechnology Education and Workforce Development

Hosted by MATEC Networks

www.matecnetworks.org





NACK is the NSF ATE National
Center for Nanotechnology
Applications and Career
Knowledge

The NACK National Center is
located at Penn State University



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Center for Nanotechnology Education and
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The Pennsylvania State University

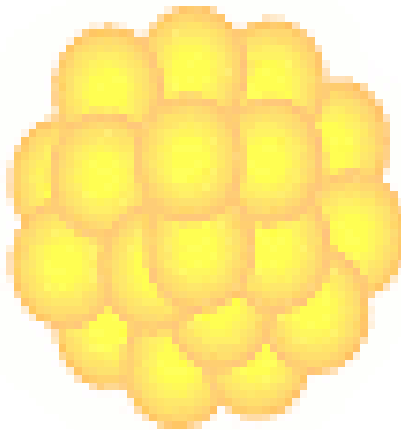


Before taking a quick tour through some of today's applications of Nanotechnology, we must ask “what is so different about the nano-scale”?



What is so Different about the Nano-Scale?

- Small size—can get a lot of nano-things in an area or volume



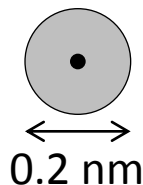
What is so Different about the Nano-Scale (continued)?

- Most atoms are at the surface and their electron distributions are different than that of an isolated atom or that of the atoms in a bulk solid

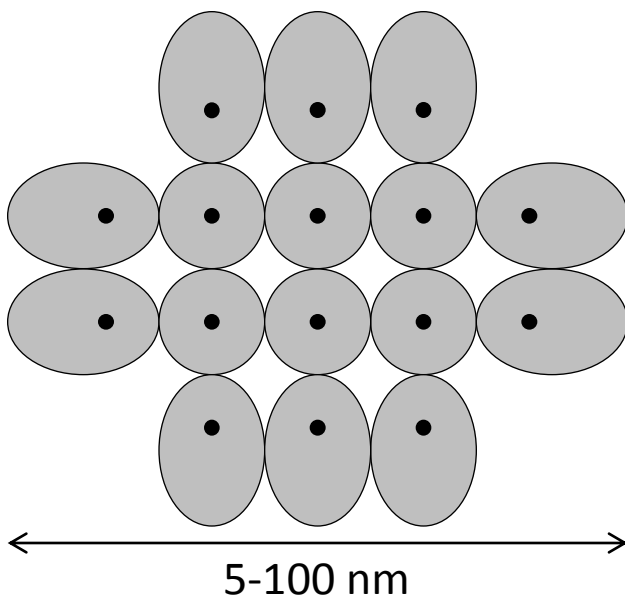


Two Dimensional Representation of an Atom, a “Regular Size” Solid, and a Nano-Size Particle

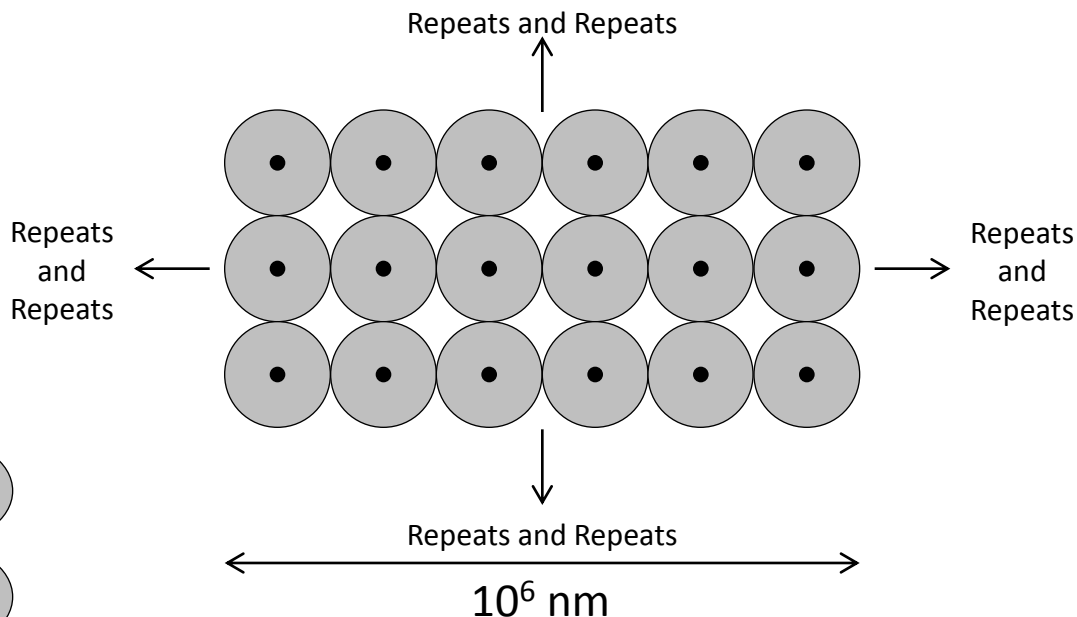
Isolated Atom



Nanoparticle



Regular “Bulk” Solid



Distorted “electron clouds” for atoms on surface of the nanoparticle. This is unlike the clouds in isolated atoms or in regular solids.

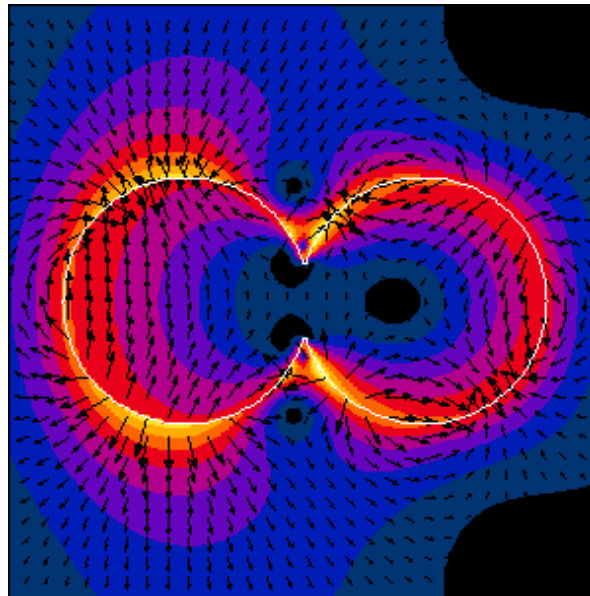
What is so Different about the Nano-Scale (continued)?

- Quantum mechanics is important for the small structures of the nano-scale (e.g., quantum dots)



What is so Different about the Nano-Scale (continued)?

- Wave properties of light are important for the small structures of the nano-scale



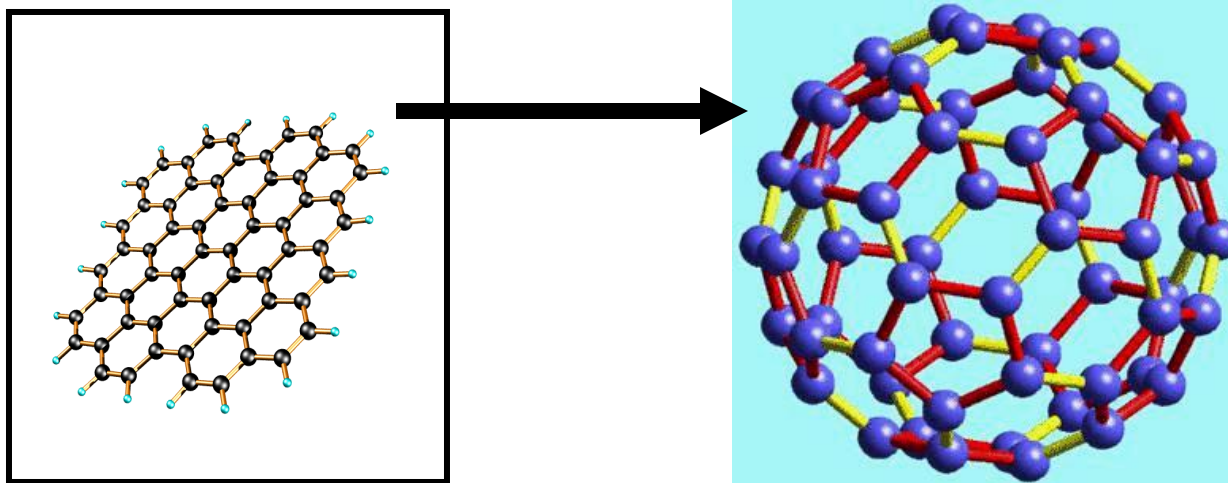
What is so Different about the Nano-Scale (continued)?

- Structures are of the same size as the “basic structures” in biology that make cells work



What is so Different about the Nano-Scale (continued)?

- Nature allows some unusual chemical bonding for nano-scale structures



These opportunities available at the nano-scale are used by engineers and scientists to make new materials and, from these new materials, come new devices and structures



Questions?



Nanotechnology is 21st Century
materials science and engineering.



What has come so far from this 21st
century materials science and
engineering?



**My government
spent billions on
Nanotechnology**

*... and all I got was this
wrinkle-free T-shirt?*



A Mixture of Some Applications---

Examples from the Simple to the Sophisticated



Some of Today's Applications of Nanotechnology

- Preventing counterfeiting



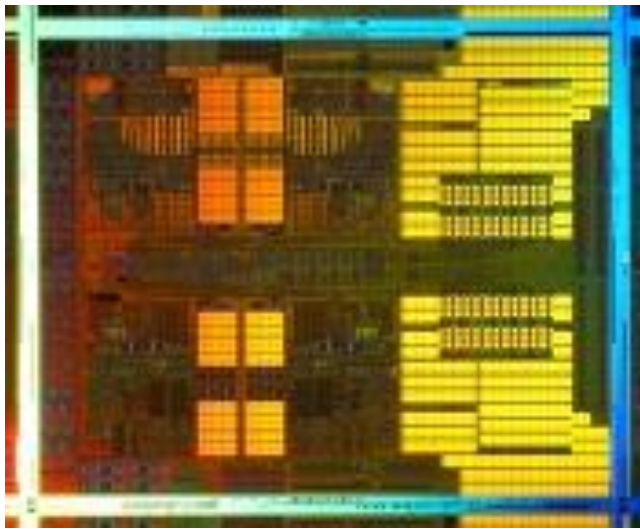
Some of Today's Applications of Nanotechnology

- Paints---to fight MRSA “super bugs”

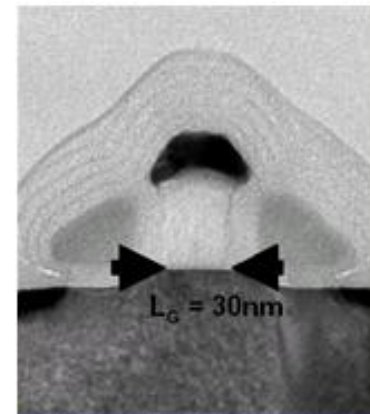


Some of Today's Applications of Nanotechnology

- Microelectronics has become nanoelectronics



AMD 45nm transistors in microprocessor



Questions?



Micro-electronics Soon?

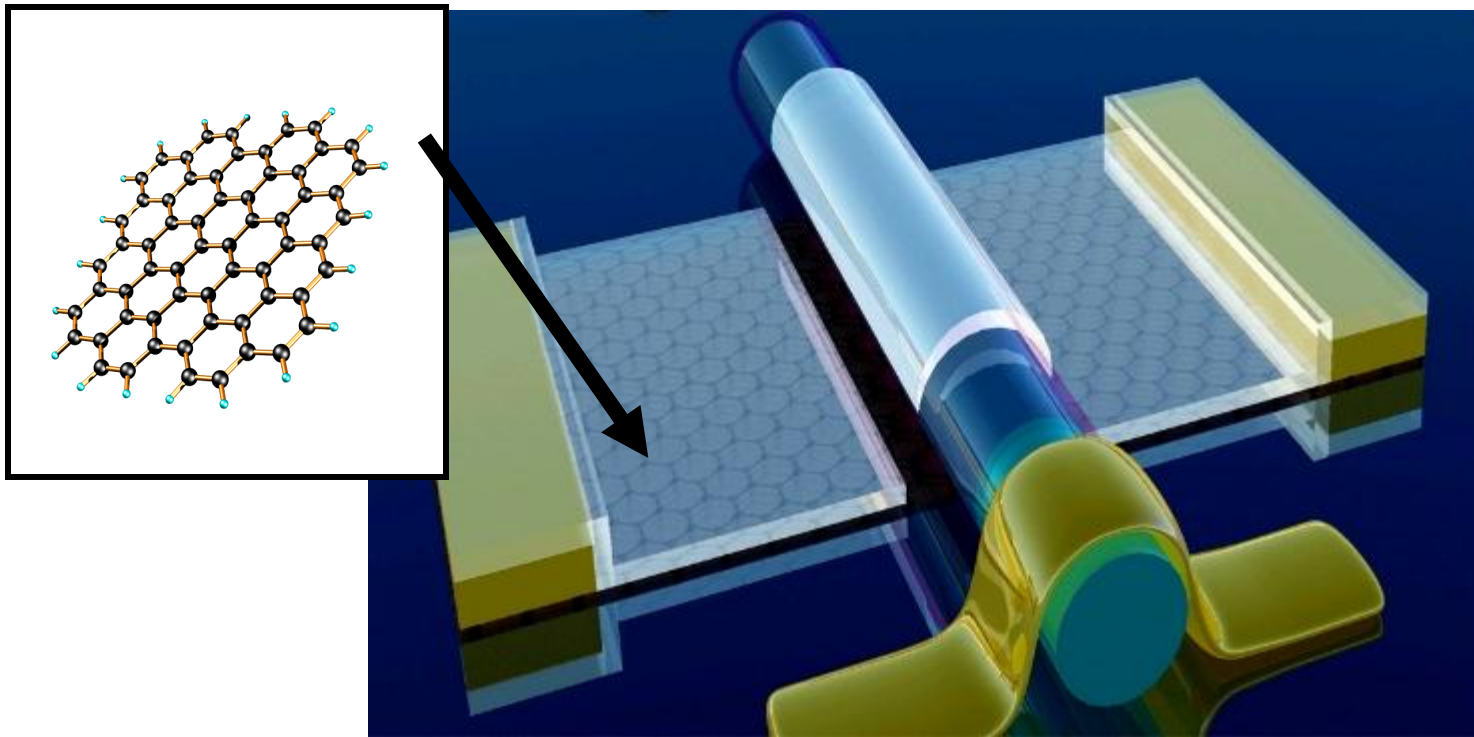


Illustration of the high-speed graphene transistor designed by UCLA researchers led by Xiangfeng Duan, the cylinder across the middle of the transistor is the self-aligning nanowire gate.

Some of Today's Applications of Nanotechnology

- Better catalysts



NPG Asia Materials research highlight
Published online 28 April 2009

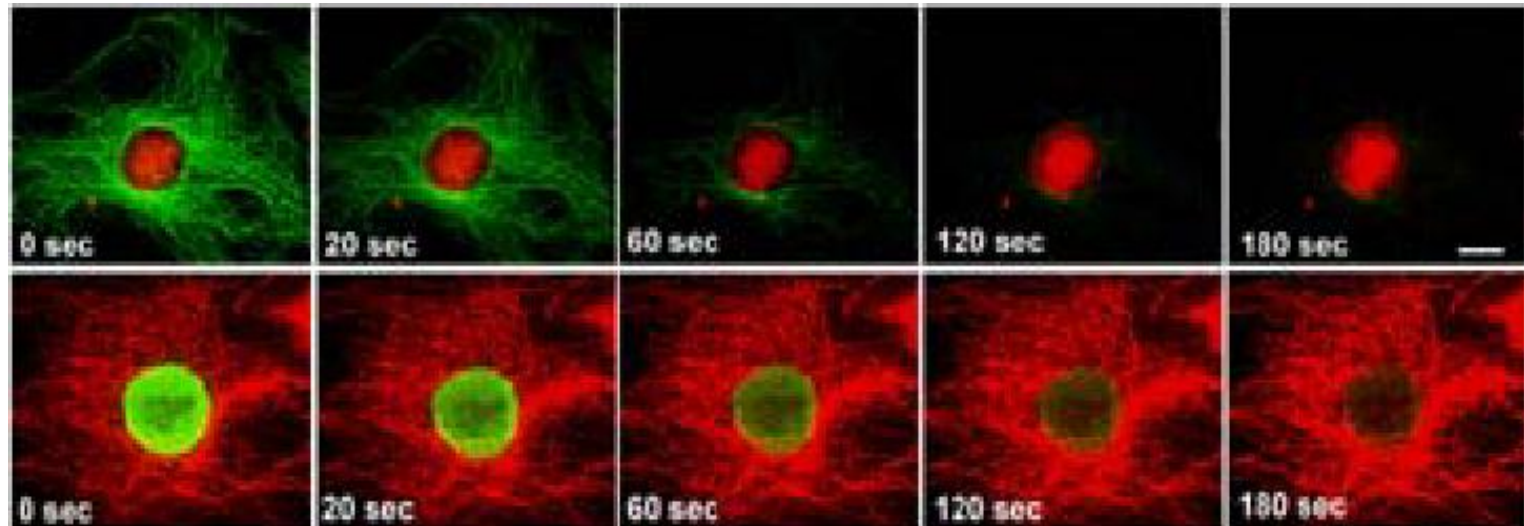
Some of Today's Applications of Nanotechnology

- Light emitting diodes (LEDs)



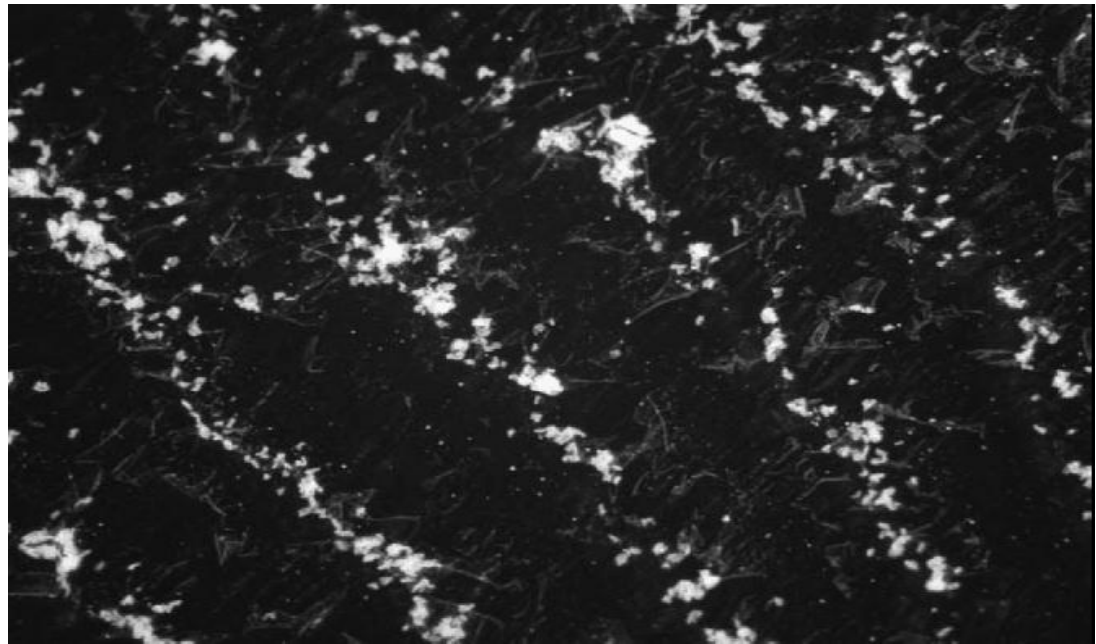
Some of Today's Applications of Nanotechnology

- Semiconductor nano-particles (quantum dots) for biology and medicine



Some of Today's Applications of Nanotechnology

- Semiconductor nano-particles (quantum dots) for forensics



Lagerholm, B.C., et al. Nano Letters 2004, 4

Some of Today's Applications of Nanotechnology

- Food Industry

Food Processing example and company	
Frying oil conditioner (OilFresh)	Tiny ceramic-zeolite nanoscale beads with enough surface area to support chemical reactions are used to inhibit breakdown of cooking oil
Packaging example and company	
Plastic bottles, tubing (Nanocor, Color Matrix)	Tiny clay nanostructures blended into plastic block the flow of gases preserving carbonation and freshness
Additive example and company	
Candy coating (Mars)	Candy encapsulated by a layer of edible mineral nano-structures to prolong freshness and inhibit melting

Some of Today's Applications of Nanotechnology

- Packaging--Nanoparticles in plastics



Some of Today's Applications of Nanotechnology

- By redesigning starch molecules on a molecular level, new biopolymer nanospheres have been formed into a new starch adhesive.
 - Natural starch particles ~ 30 microns
 - Nano-version particles 50 to 150 nm in size.
- These nanoparticles have 400 times more surface area than natural starch granules.



Some of Today's Applications of Nanotechnology

- Information Storage/Communications



The read-write head in this IBM TS1130 tape drive (left), which can store one terabyte of data, is based on GMR. Inside a GMR-based hard-disk drive (right).

W. Patrick McCray

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Questions?



Some of Today's Applications of Nanotechnology

- Coatings

Pants using a “Lotus” coating--nano-scale spikes that work to prevent grease and stain molecules from bonding to the fabric.



Some of Today's Applications of Nanotechnology

- Additives

Carbon nano particles are used to make a softer compound without sacrificing the wear rate of the tire tread. Each nano-particle is only 1/10th of the size of standard carbon black particles used in tires.



Some of Today's Applications of Nanotechnology

- Medicine

Anti-cancer drug for the treatment of refractory ovarian cancer and AIDS-related Kaposi's sarcoma. First marketed product to use lipid nanoparticles that incorporate a polyethylene glycol (PEG) coating. This coating helps evade the potential impact of the immune system and enables the precise delivery of drugs to disease-specific areas of the body. Approved by the FDA in February 2005.



Some of Today's Applications of Nanotechnology

- We just took a quick look at some of today's applications of nano-technology.
- The Project on Emerging Nanotechnologies (The Pew Charitable Trust) reports there are currently 800+ nano-technology products on the market.

<http://www.nanotechproject.org/>



Nanotechnology:
Over Hyped—may be.
Not Understood—probably by most.
Undersold—definitely.



Courtesy of www.dilbert.com

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Questions?



How Can We Better Serve You?

Whether you are joining us live or watching the recorded version of this webinar, please take 1 minute to provide your feedback and suggestions.

<http://questionpro.com/t/ABkVkZHP3W>



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NACK's Webinar

Nanotechnology Applications in Today's World

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Oct 10: Building a NanoLab: Equipment and Program Overview

Nov 19: Environmental Applications of Nano

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