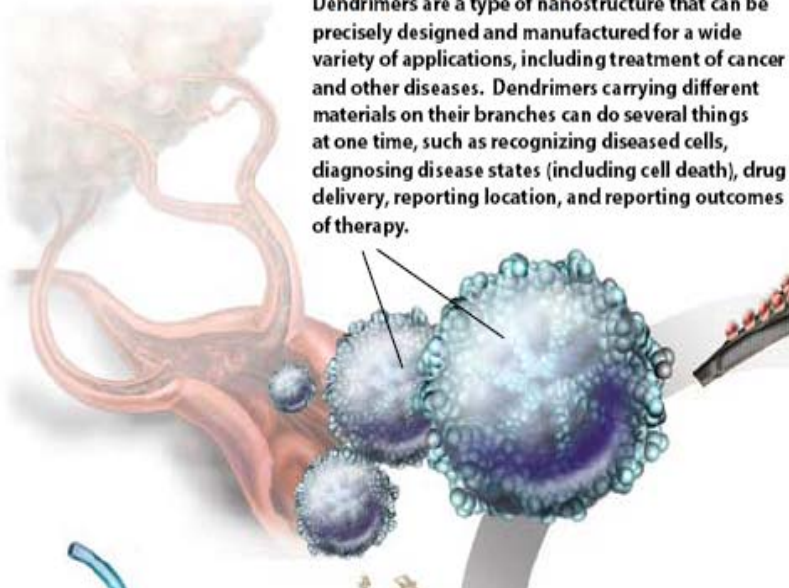


Nanotechnology Applications and Products

Drug-Delivery Techniques

Dendrimers are a type of nanostructure that can be precisely designed and manufactured for a wide variety of applications, including treatment of cancer and other diseases. Dendrimers carrying different materials on their branches can do several things at one time, such as recognizing diseased cells, diagnosing disease states (including cell death), drug delivery, reporting location, and reporting outcomes of therapy.



Nanofilms

Different nanoscale materials can be used in thin films to make them water-repellent, anti-reflective, self-cleaning, ultraviolet or infrared-resistant, anti-fog, anti-microbial, scratch-resistant, or electrically conductive. Nanofilms are used now on eyeglasses, computer displays, and cameras to protect or treat the surfaces.



Nanotubes

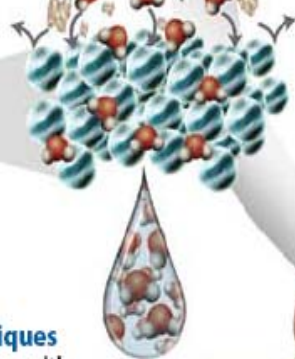
Carbon nanotubes (CNTs) are used in baseball bats, tennis racquets, and some car parts because of their greater mechanical strength at less weight per unit volume than that of conventional materials. Electronic properties of CNTs have made them a candidate for flat panel displays in TVs, batteries, and other electronics.



Nanotechnology and Environment

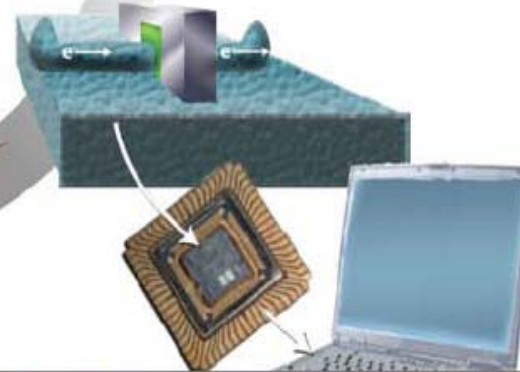
Water-Filtration Techniques

Researchers are experimenting with carbon nanotube-based membranes for water desalination and nanoscale sensors to identify contaminants

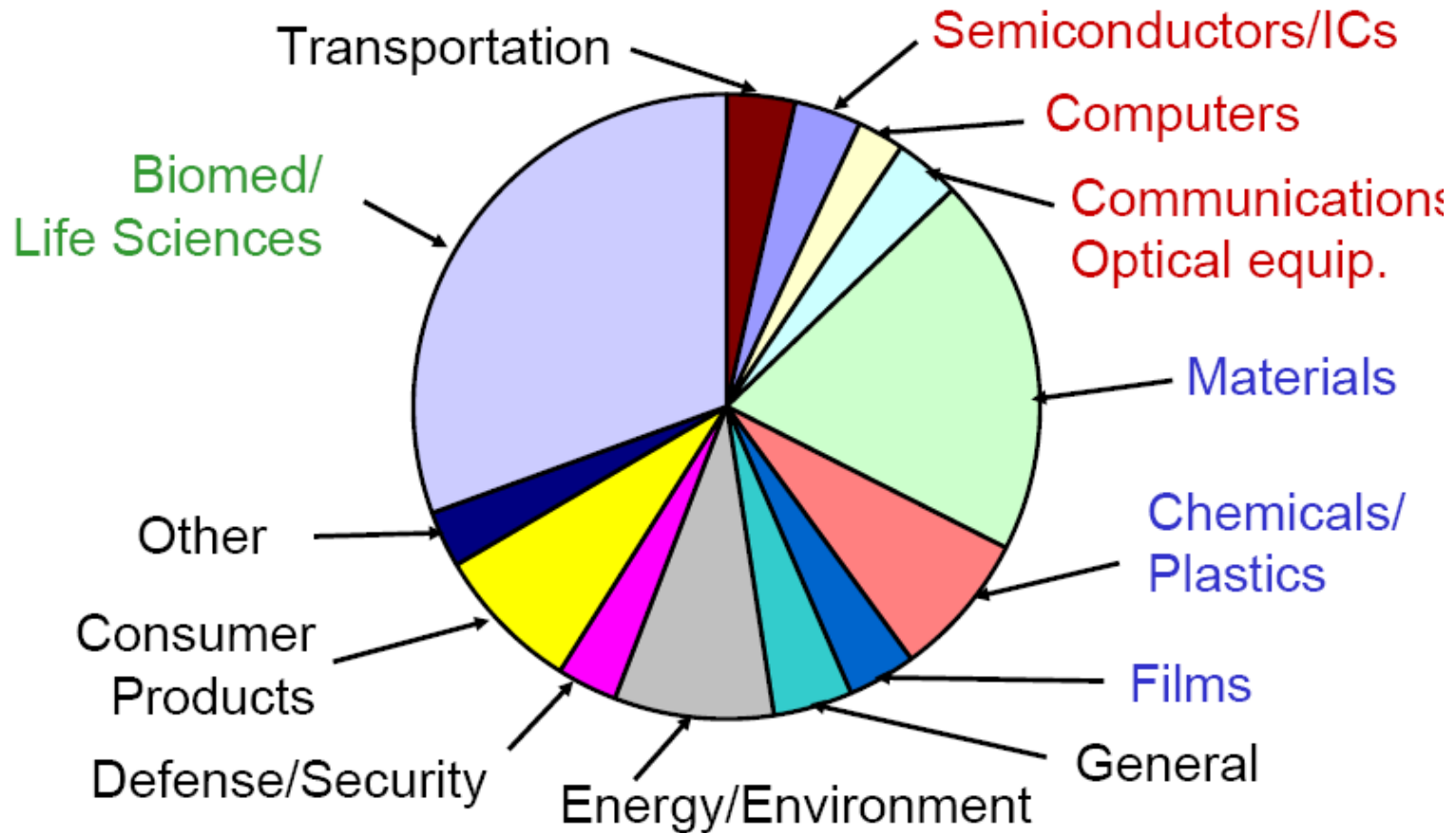


Nanoscale transistors

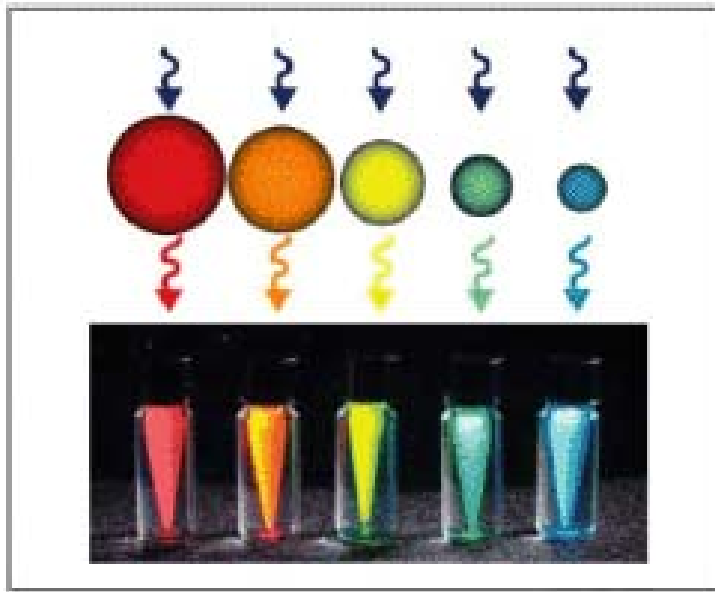
Transistors are electronic switching devices where a small amount of electricity is used like a gate to control the flow of larger amounts of electricity. In computers, the more transistors, the greater the power. Transistor sizes have been



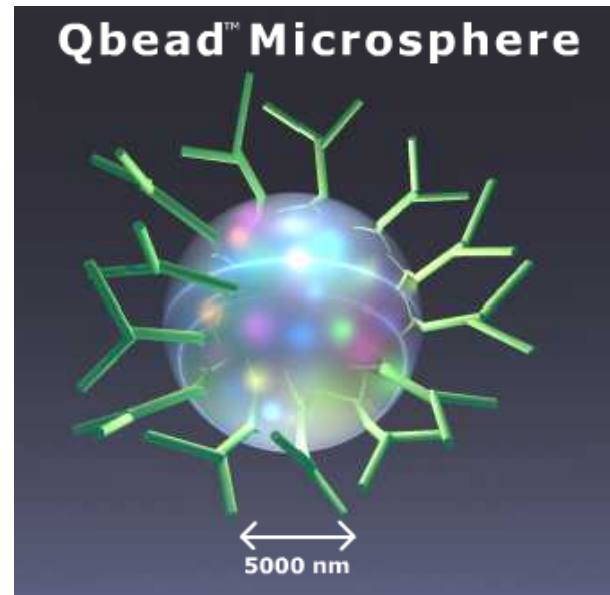
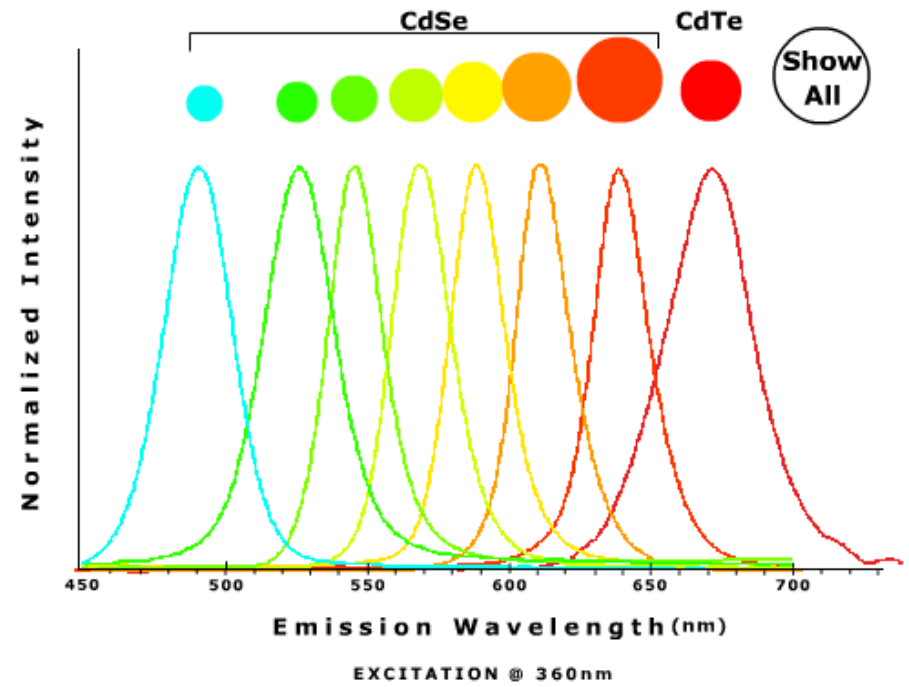
Target industries for nanosuppliers (Number of companies= ~600)



Source: EmTech Research

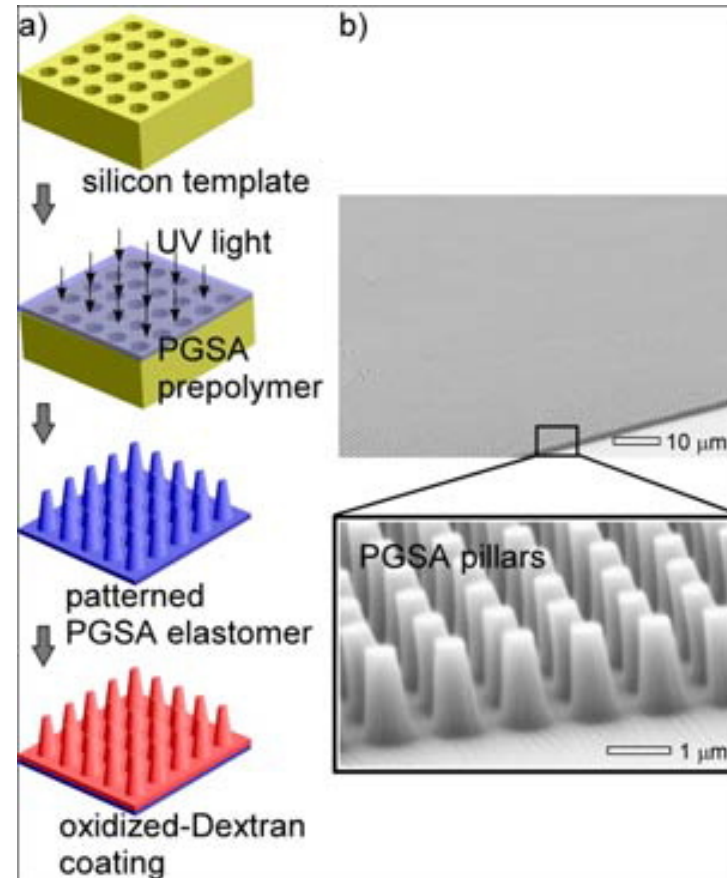
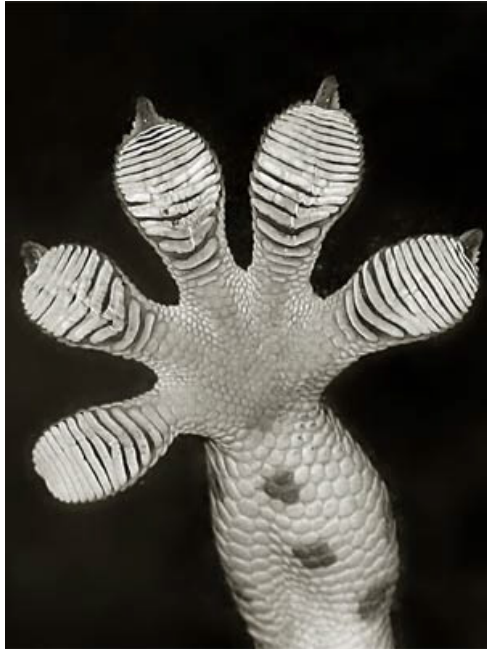


Vials of Quantum Dots. This picture of vials containing Qdot® quantum dots was captured after the samples were placed in front of a common UV hand lamp. All samples are induced to emit their respective colors even though a single source was used to excite them. The colored spheres illustrate the relative sizes of the CdSe quantum dots in the vials.



Biomedical Applications

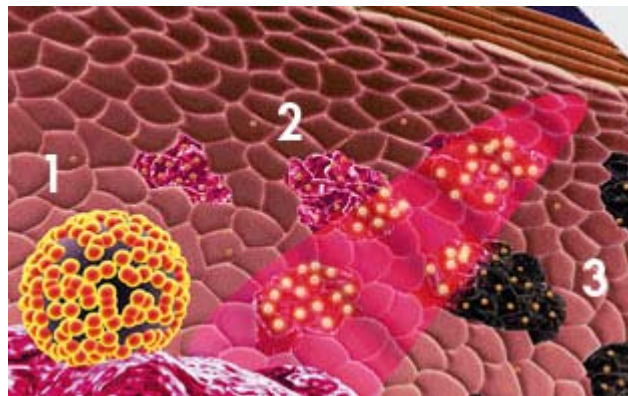
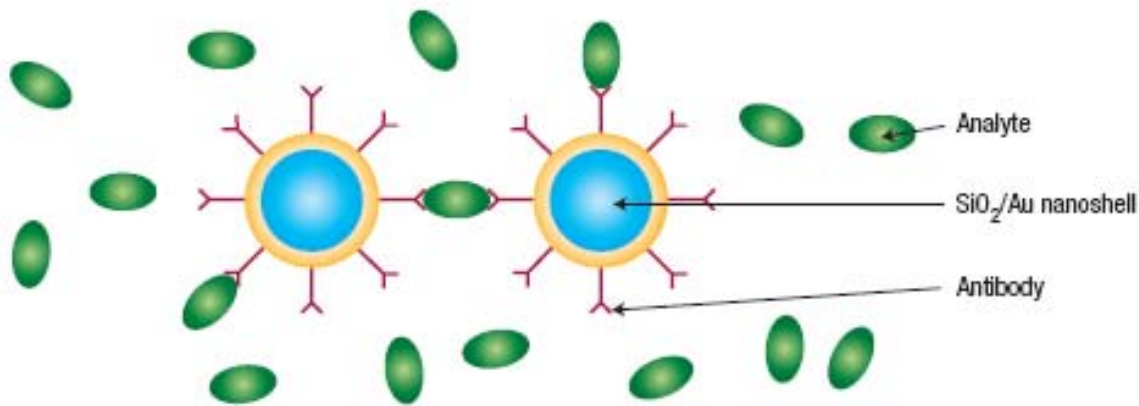
Gecko Bandage



MIT's gecko-inspired medical adhesive consists of a "biorubber" base patterned to have pillars that are less than a micrometer in diameter and three micrometers in height. Layered on top is a thin coating of a sugar-based glue. Tests in live rats suggest that the adhesive could be an effective operating room tool for closing surgical wounds

Langer & Karp

Designing gold "nanoshells" that seek and destroy tumors.

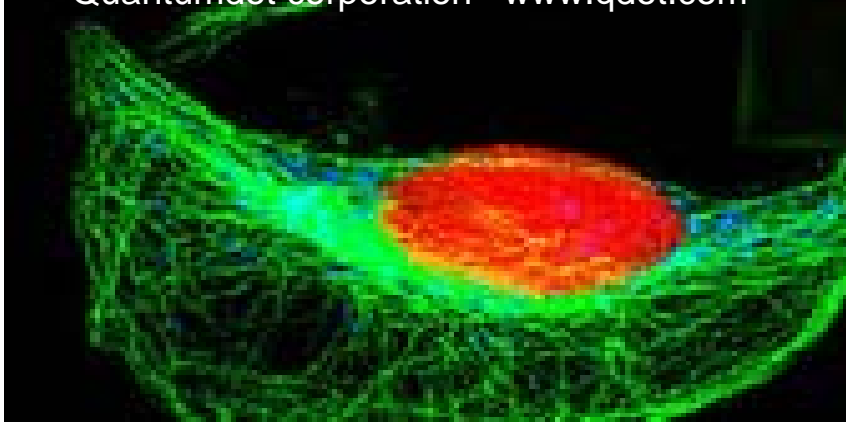


Once roughly 20 nanoshells cover each tumor, a brief exposure to near-infrared light, which passes harmlessly through tissue, illuminates the shells. Next, doctors deliver a more intense near-infrared dose, heating only bound tumors

QDOT[®] 565, 605 & 655 ANTIBODY CONJUGATION KIT NOW AVAILABLE

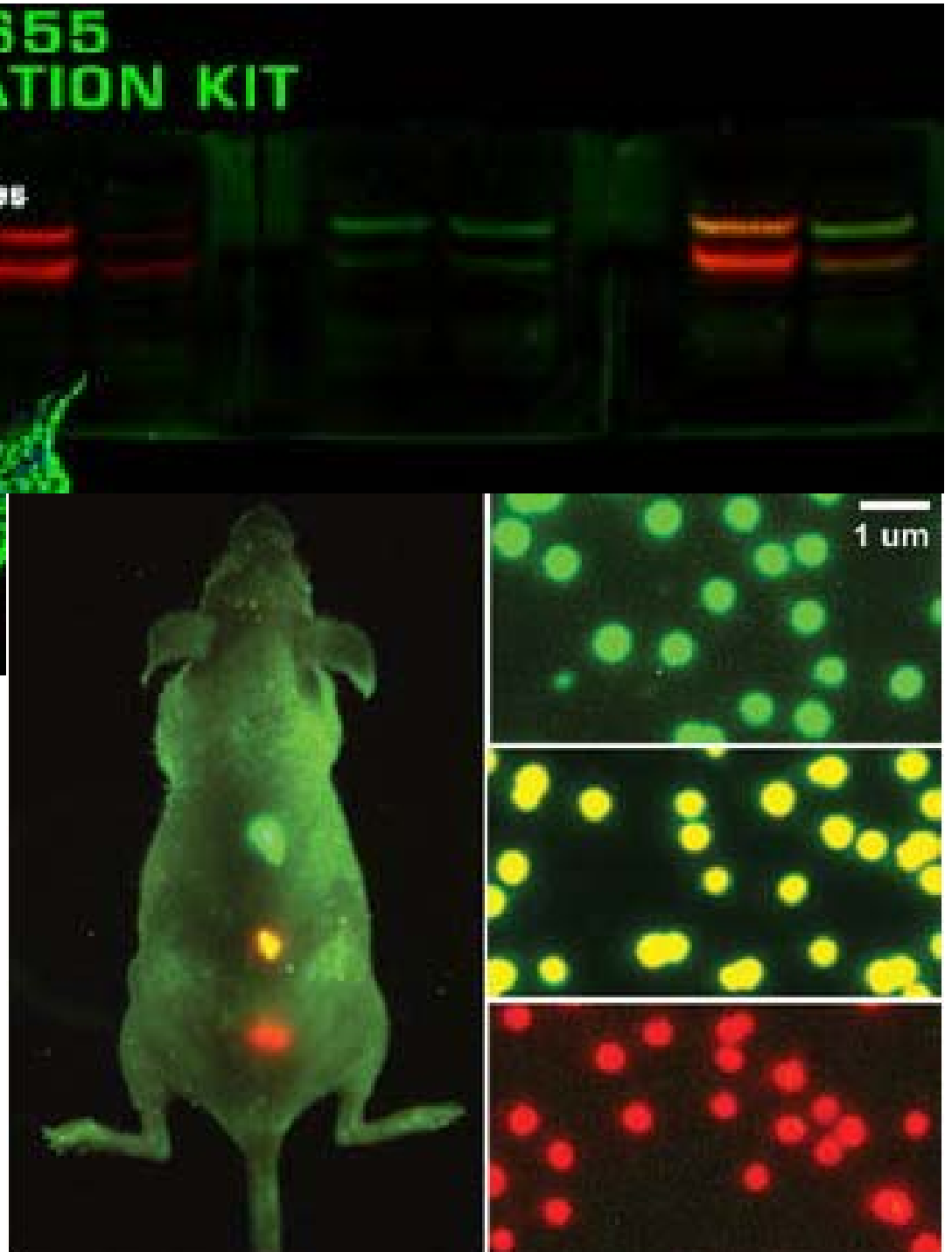
Now you can conjugate your antibodies
to Qdot nanocrystals.

Quantumdot corporation www.qdot.com



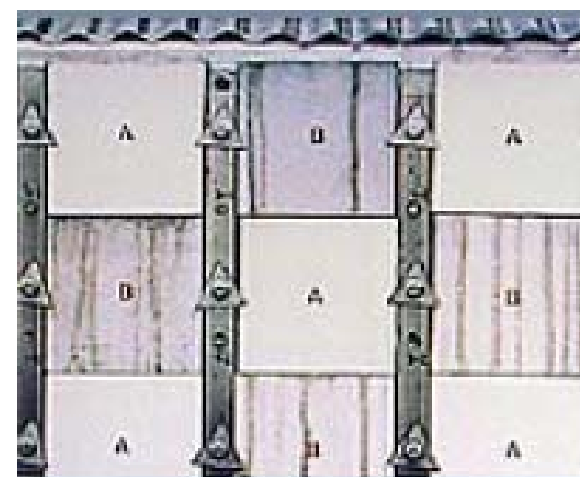
Nie and coworkers use the quantum dot probes to target and image human prostate cancer cells growing in mice. In passive targeting, the quantum dots accumulate in the tumors by taking advantage of the leaky blood vessels that supply tumors. The researchers actively target the tumors by decorating the surface of the probes with antibodies that bind to tumor-specific antigens.

Quantum dots emitting different wavelengths are visible after injection into a mouse. NATURE BIOTECHNOLOGY 2004

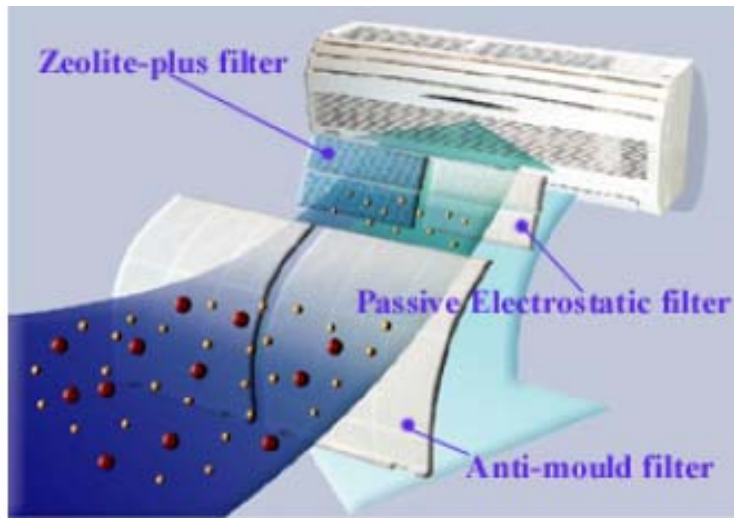


Photocatalysis Applications of Titanium Dioxide

- fog proof, and self cleaning glass
- anti-bacterial, anti-viral, fungicidal
- anti-soiling, self cleaning
- deodorizing, air purification
- water treatment, water purification

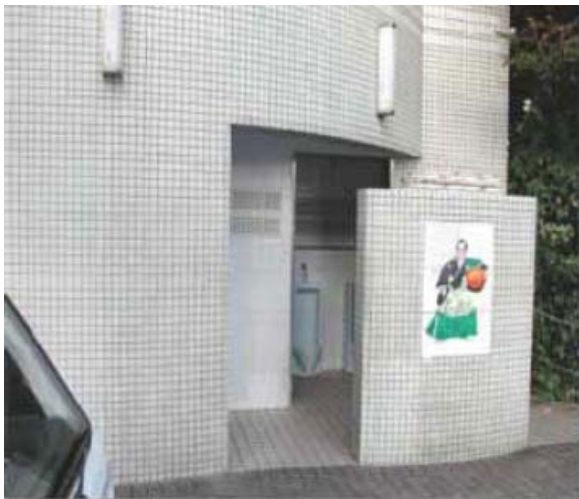


TOSHIBA



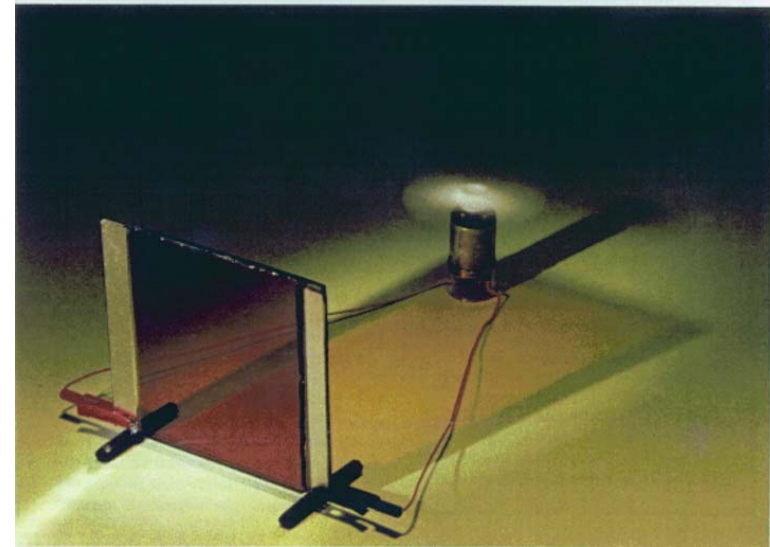
The new deodorizing and anti-bacteria zeolite-plus filter, with its waterproof thread, is specially designed to withstand humid operating conditions.

Expose the filter to the sun light for three to six hours. The titanium dioxide (TiO_2) contained in its fiber will regenerate the filter through photo-catalytic oxidation, powered by the sun's ultraviolet light.



Photochemical Solar Cells

- Development of SC nanocluster based cells with more than 10% power conversion efficiency. Photon-to-photocurrent efficiency up to 100% has been claimed!



Source: <http://dcwww.epfl.ch/icp/ICP-2/icp-2.html>

Each module 24 cm x24 cm

AISIN & TOYOTA

December 11, 2008

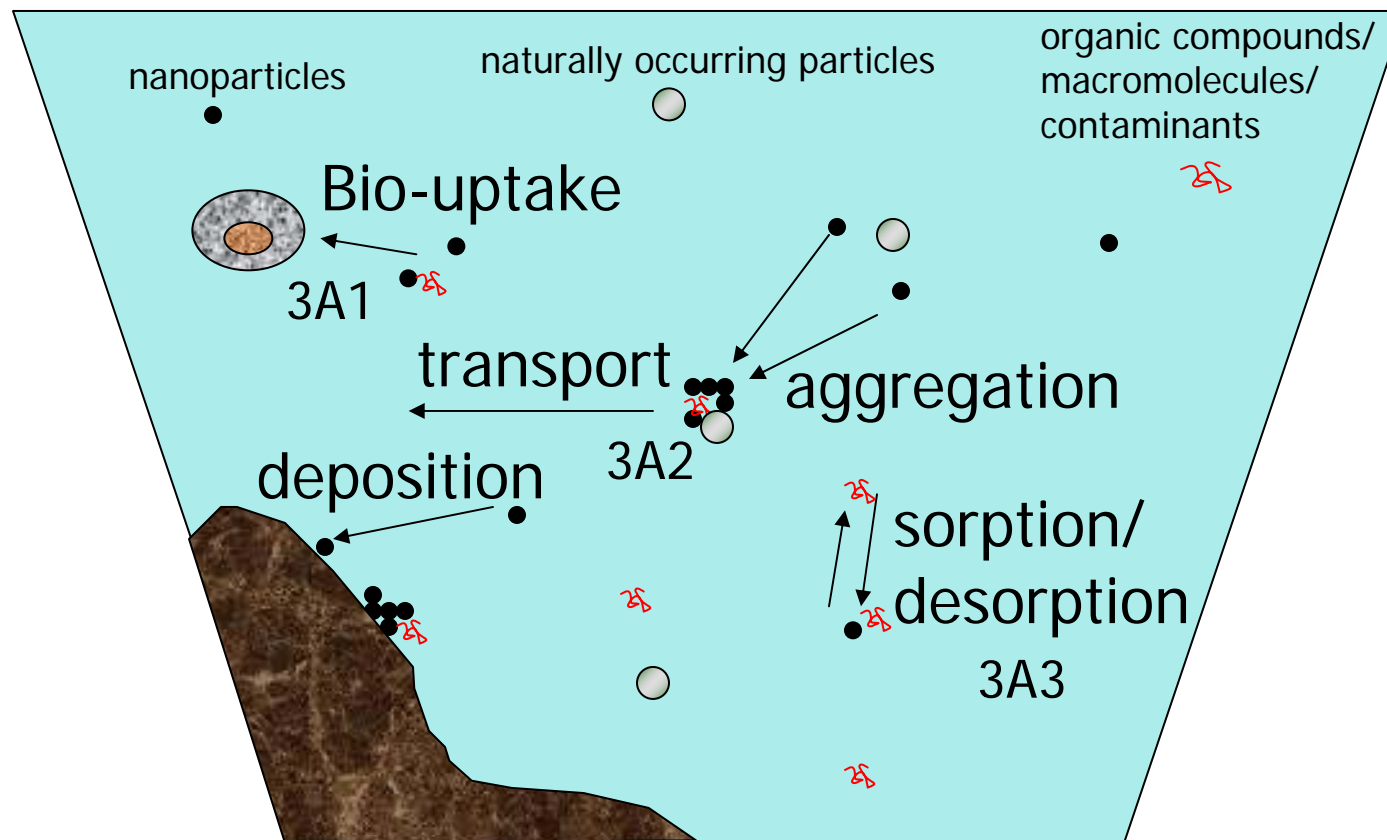
NRC report blasts federal research strategy for addressing risks of nanomaterials

[Britt E. Erickson](#)

THE FEDERAL GOVERNMENT'S research plan for assessing the potential environmental, health, and safety (EHS) risks of nanomaterials is inadequate, concludes a new report from the [National Research Council](#). The report emphasizes the need for a national strategic plan—one that includes a broader group of stakeholders and goes beyond what the federal multiagency National Nanotechnology Initiative can develop.

A coalition of concerned stakeholders, including industry trade groups, nanomaterial manufacturers, and environmental organizations, reacted to the report by issuing a joint statement that echoes the concerns raised by the NRC committee. "The NRC report lends all the more urgency to our coalition's call for the independent development of a comprehensive road map to guide federal research on the EHS implications of nanotechnology,"

Nanoparticles in Aqueous Environments



How Nanostructures might impact our Environment?

- Particle-mediated transport
 - size
 - surface chemistry (hydrophobic)
- Potential for bio-assimilation
 - direct consequences
 - associated contaminants

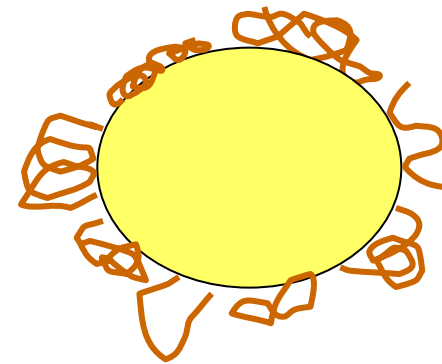
- **Size and Shape**
 - Size distribution
 - Shape
- **State of Dispersion**
 - Agglomeration/Aggregation
- **Physical and Chemical Properties**
 - Crystalline phase and crystallite size
 - Water solubility
 - Electro-optical properties
- **Surface Area and Porosity**
- **Surface Chemistry**
 - Surface composition
 - Catalytic properties
 - Surface charge
 - Reactivity
 - Adsorption/desorption of molecules

Biouptake and Adsorption

- Many types of molecules will adsorb to nanoparticles in complex aqueous environments
- Adsorbed molecules may dictate biological interactions, especially biouptake

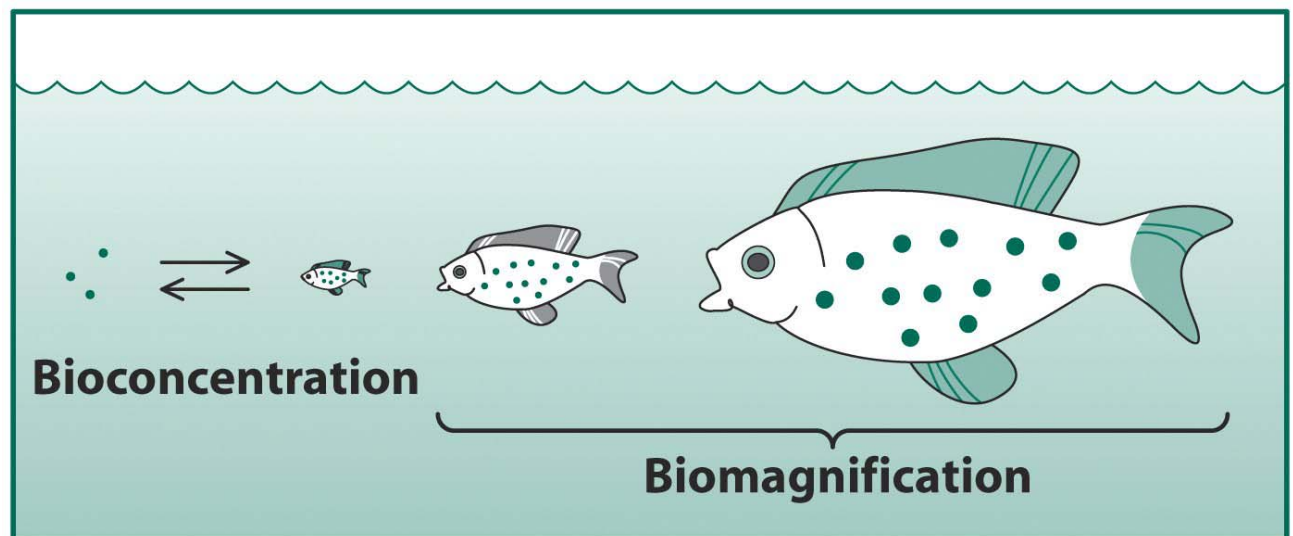
Biomolecules (i.e. proteins)

Synthetic chemicals (i.e. pesticides)

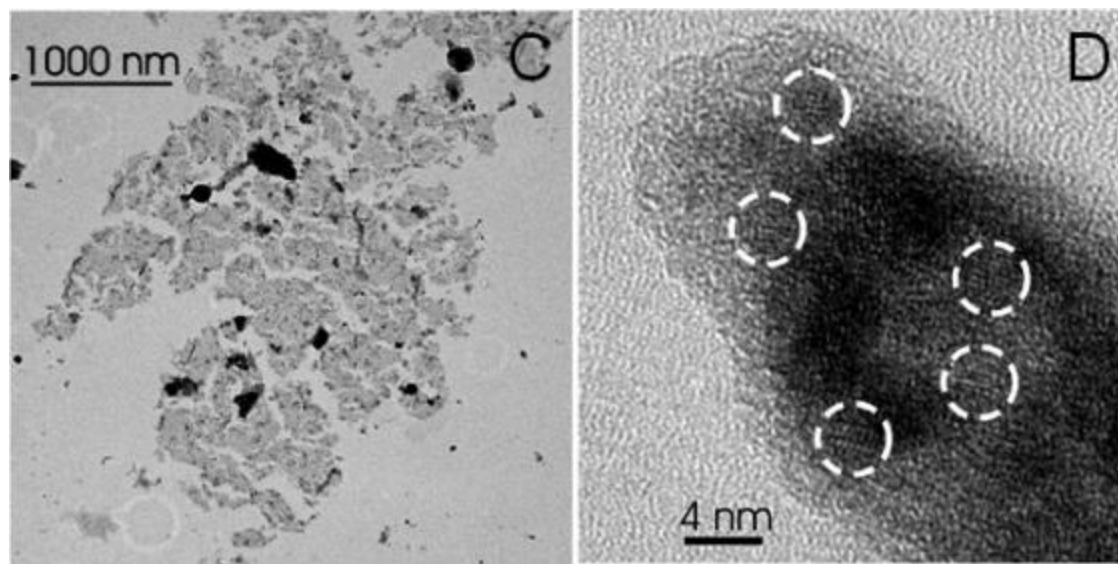


Bioaccumulation

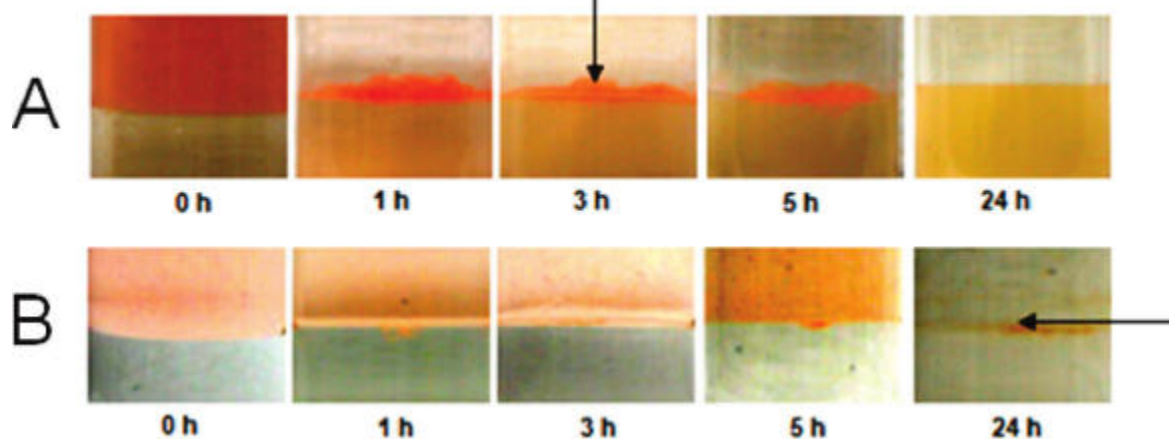
- Accumulation of a substance within a species due to lack of degradation or excretion
- Most nanoparticles are not biodegradable
- If nanoparticles enter organisms low in the food web, they may be expected to accumulate in organisms higher in the food web



Binding of CdSe Quantum Dots to Himic Substances



(C) Low-magnification and (D) HRTEM images showing phase-transferred QDs embedded in HA



Toxic Potential at Nano Level

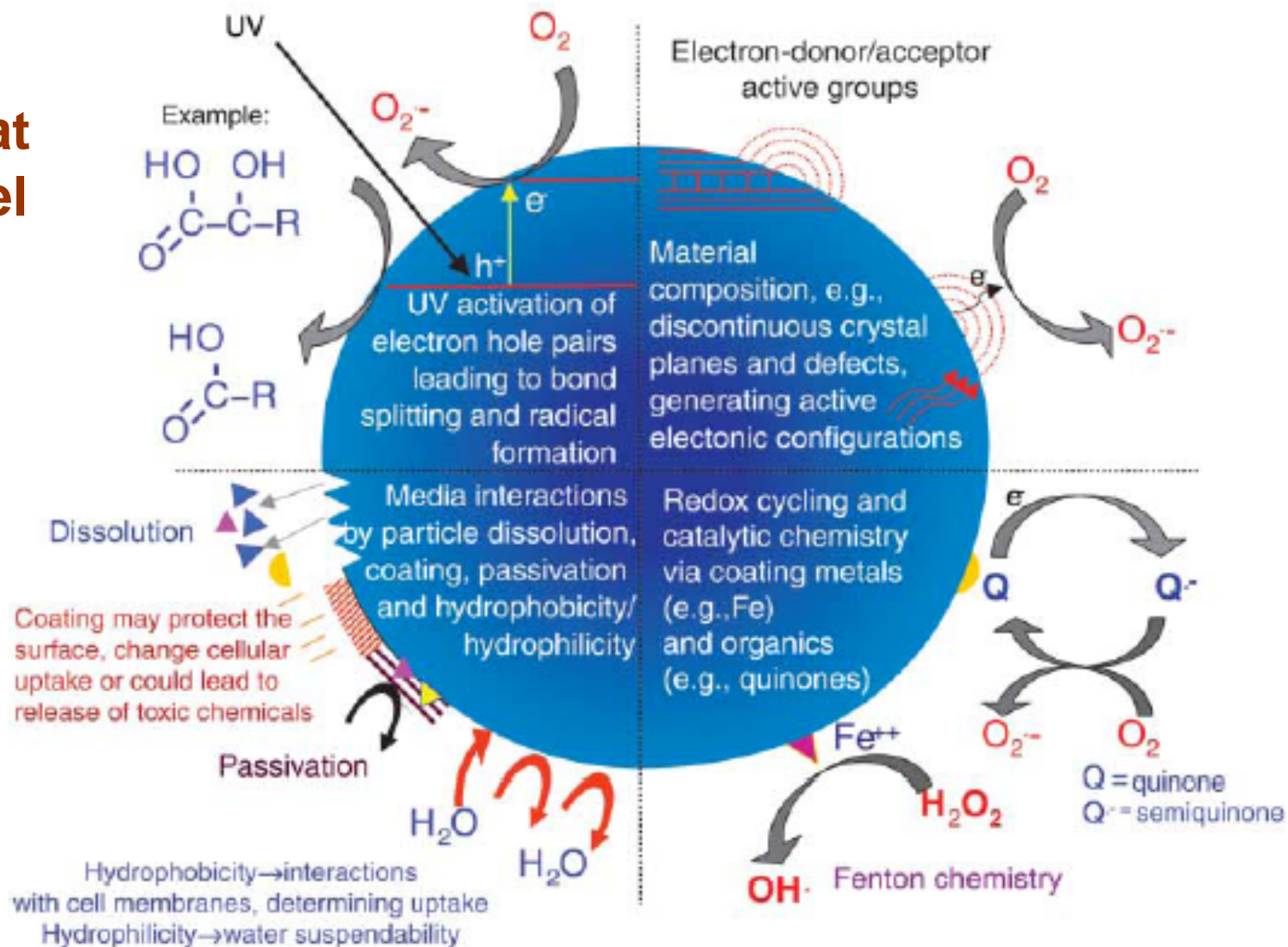
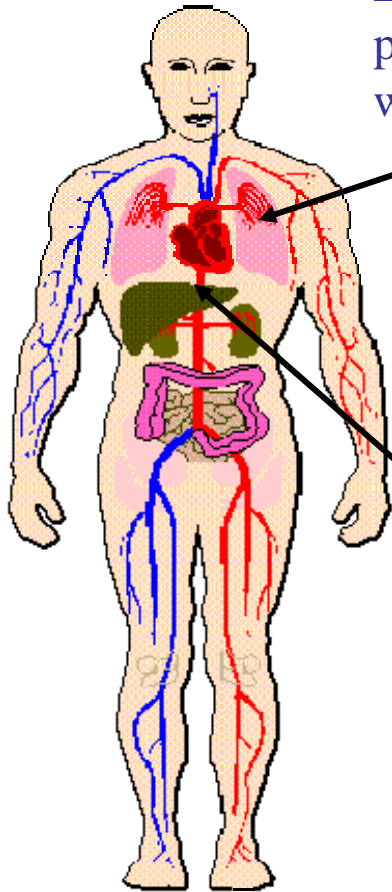


Fig. 2. Possible mechanisms by which nanomaterials interact with biological tissue. Examples illustrate the importance of material composition, electronic structure, bonded surface species (e.g., metal-containing), surface coatings (active or passive), and solubility, including the contribution of surface species and coatings and interactions with other environmental factors (e.g., UV activation).

Understanding Biological Response

Inhaled particles induce inflammation in respiratory tract, causing tissue damage. Example: Inhalation of silica particles in industrial workers causes “silicosis”.



Ingested nanoparticles may cause liver damage. Ingested nanoparticles (i.e. for oral drug delivery) have been found to accumulate in the liver. Excessive immune/inflammatory responses cause permanent liver damage.

- Translocation from portal of entry to target organs
- Protein binding properties
- Cellular uptake
- Accumulation and retention

Nano-tech Street Protest on Chicago's Magnificent Mile

by [TreeHugger](#) on 05.12.05

The protest group "THONG", this week, used Street-Theater tactics on Chicago's Michigan Avenue to draw attention to one of the first commercial nano-tech involved consumer products, a branded line of stain and water repellent clothing.

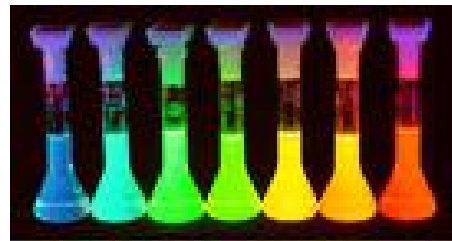
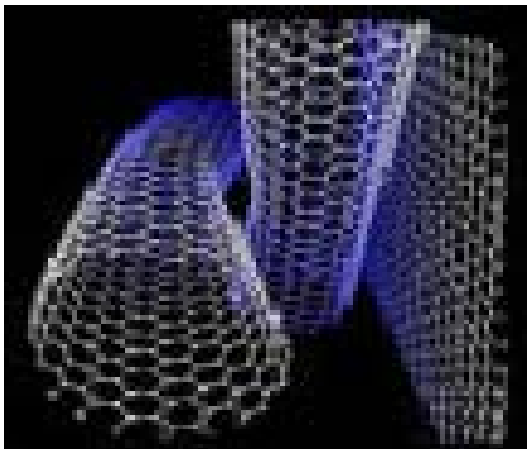


National Toxicology Program: Nanotechnology Safety Initiative

- Research is underway to determine risks of specific nanomaterials and general characteristics related to interactions with the environment and the body.
- Need a coordinated approach among regulatory and research agencies.

NTP initiating toxicology studies of:

- Nanocrystalline semiconductors (e.g. “quantum dots”)
- Carbon nanotubes (CNTs) & fullerenes
- Nanoscale metal oxide particles (e.g. TiO_2)



Lexon Nano-Silver Sock

