

Nanotechnology: Opportunities and Challenges for EPA

EPA Millennium Lecture Series

Frontiers in Nanotechnology
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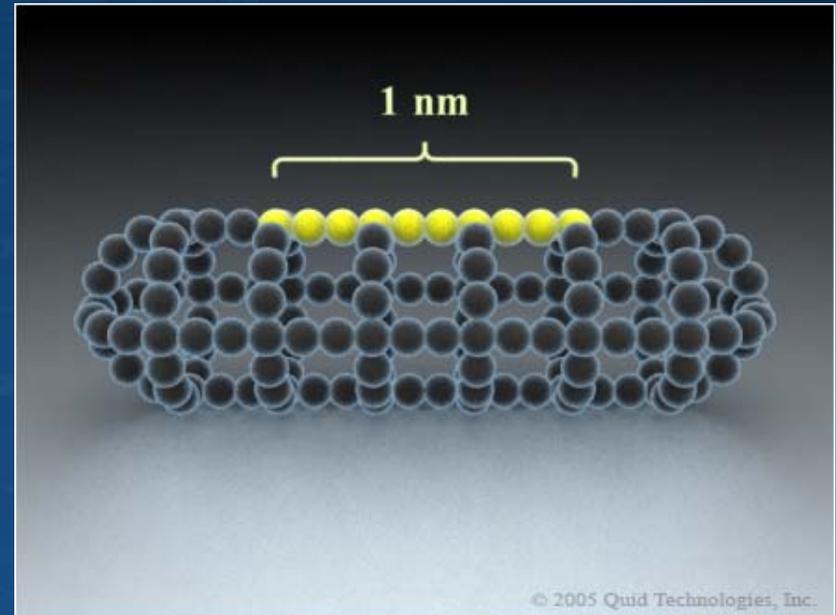


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Nanotechnology Overview

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- Broadly refers to using materials and structures with nanoscale dimensions of 1 to 100 nanometers (nm)
- No one definition of nanotechnology



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Types of Nanoscale Materials

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- Naturally occurring
- Incidental
- Intentionally engineered

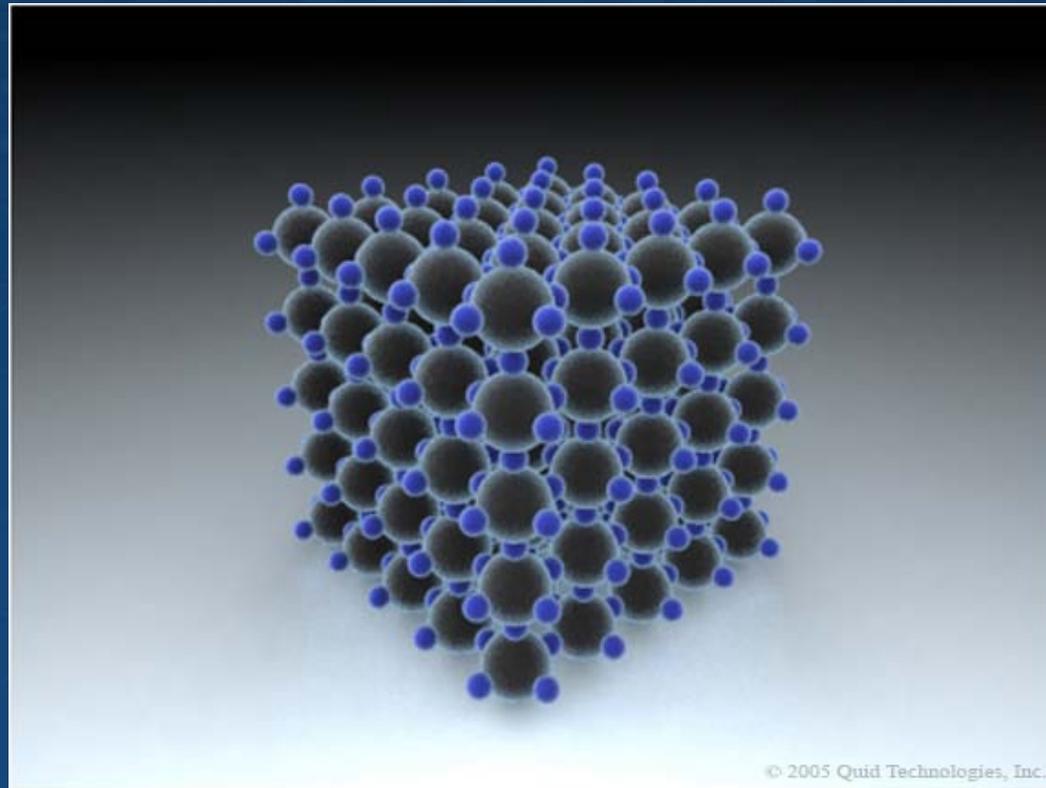


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Basic Structure of Nanotechnology

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Nanoparticle/Nanocrystal

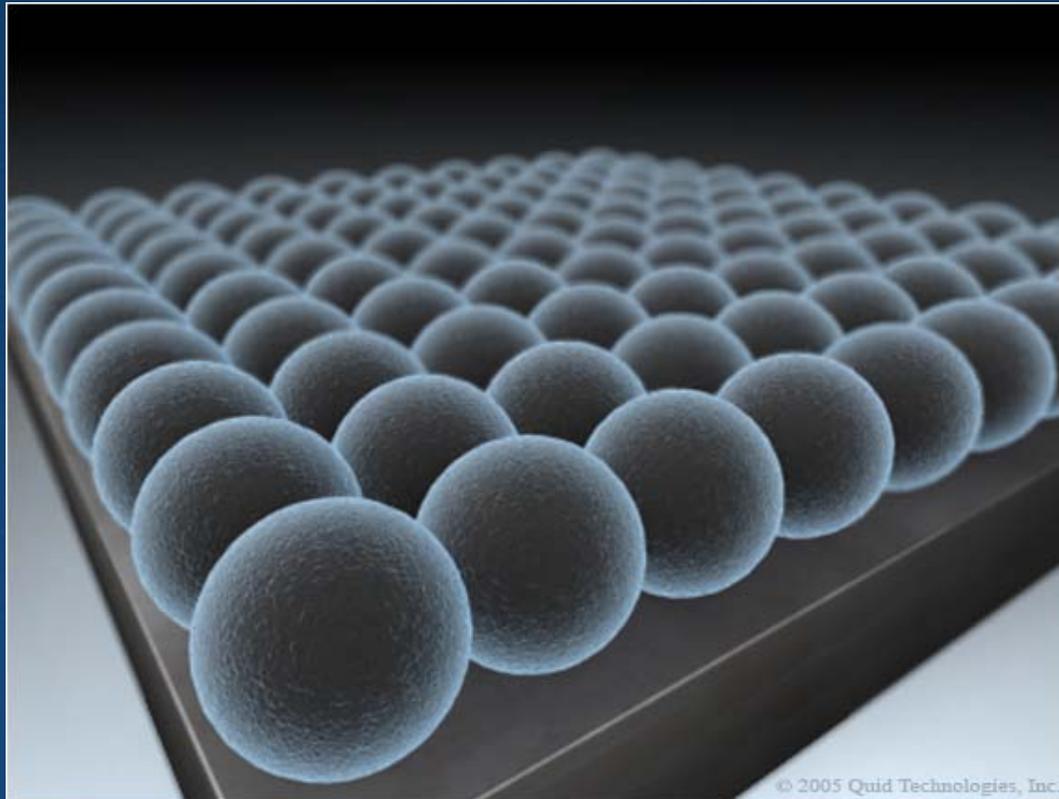


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Basic Structure of Nanotechnology (cont'd)

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Nanolayer

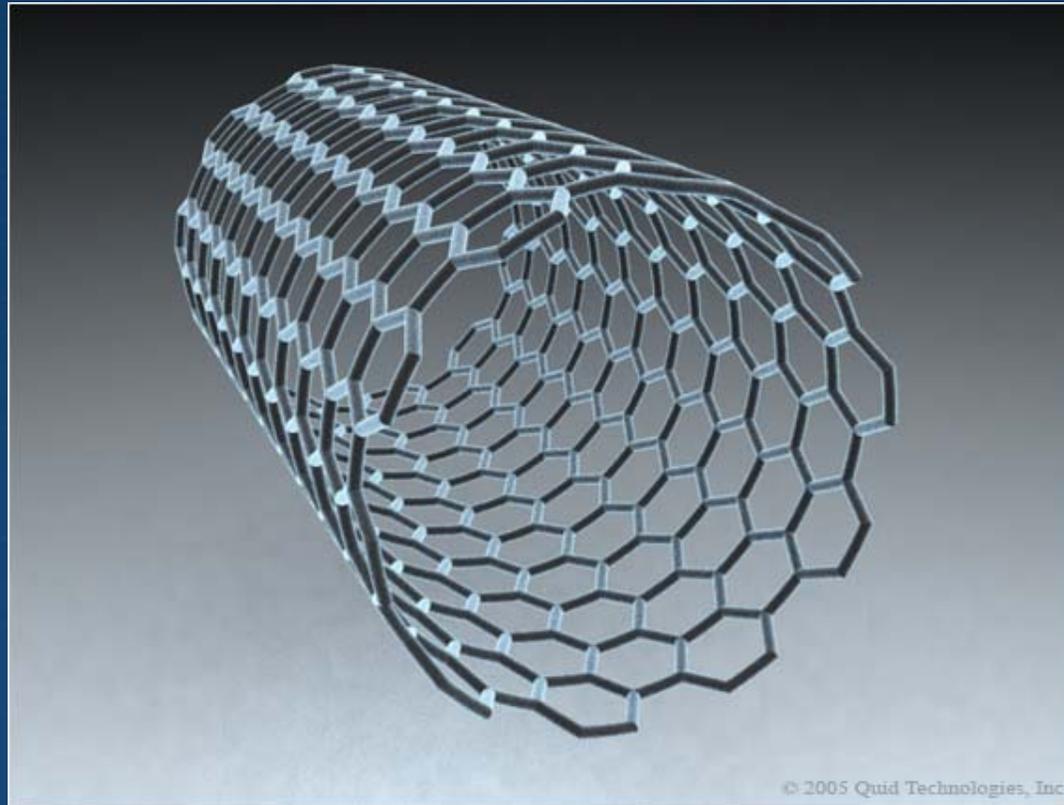


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Basic Structure of Nanotechnology (cont'd)

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Nanotube



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Nanotechnology Is About Size and Structure

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- Manipulating materials at the molecular level result in materials that exhibit desired properties, including:
 - Improved catalysis
 - Improved mechanical properties
 - Improved optical properties
 - Increased electrical conductivity



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Environmental Applications

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- Pollution prevention
 - Treatment/remediation
 - Sensors/detection
 - Green manufacturing

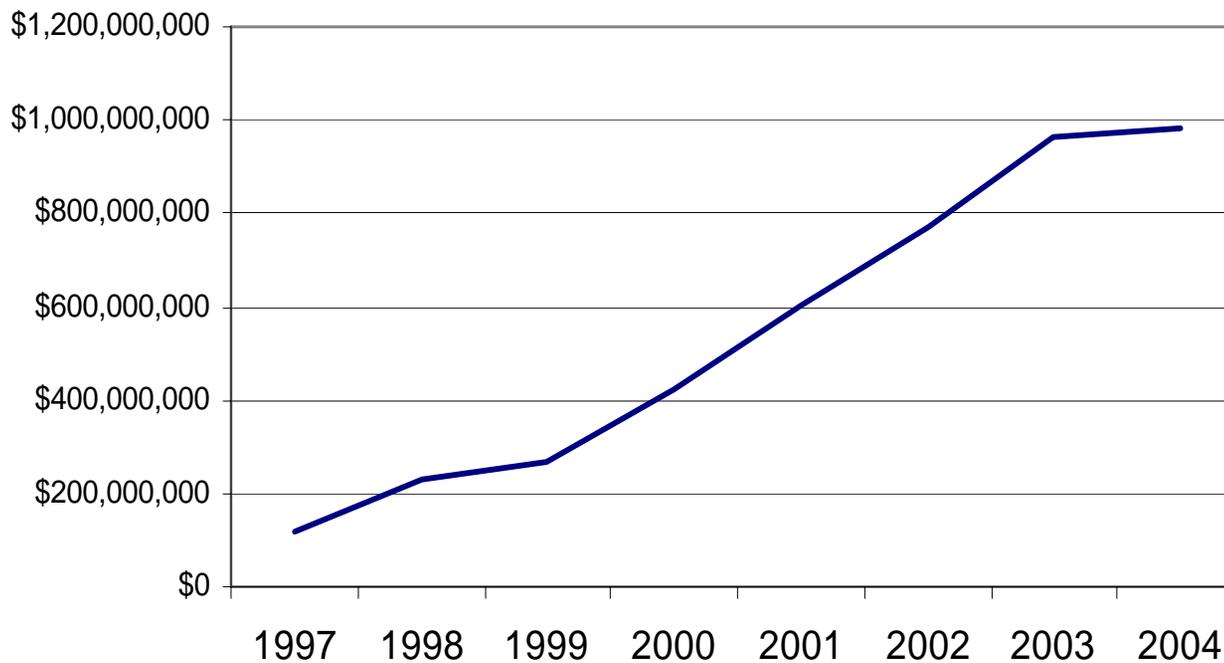


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U.S. Spending on Nanotechnology

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Federal Funds per Fiscal Year



Fiscal Year	Federal Funds
FY 2005 (Proposed)	\$982 million
FY 2004	\$961 million
FY 2003	\$774 million
FY 2002	\$604 million
FY 2001	\$422 million
FY 2000	≈ \$270 million
FY 1999	\$232 million
FY 1997	\$116 million



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Environmental Health Issues

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- Some believe that nanostructures/nanomaterials have not been adequately studied
- Unknown toxicity of some nanomaterials
 - Fate of such structures in the environment
 - The bioassimilation of such structures in ecosystems
 - Mobility and persistence of nanomaterials
 - Transformation/degradation products unknown



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Human Health Issues

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- EPA has expressed concern about the effect small particles have on human health
 - National Ambient Air Quality Standards (NAAQS) for “fine” particulate matter (defined as having a diameter of 2.5 or less microns)
 - Body of additional data on health effects
- Questions regarding the ability of nanoparticles to cross the cell barrier
- Proteins absorbed onto nanoparticles could lead to some autoimmune disorders
- Other issues



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Environmental Laws

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- Toxic Substances Control Act (TSCA)
- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Resource Conservation and Recovery Act (RCRA)
- National Environmental Policy Act (NEPA)



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TSCA

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- Section 5 new chemical review
- Section 6 authority
- Section 8(e)



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RCRA

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- Subtitle C authority to regulate waste deemed “hazardous”
- Facilities that generate such materials could be regarded as “generators” under Section 3002
- Facilities that treat, store, or dispose of such materials could be subject to regulation under Section 3004



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CAA

- EPA has issued standards for fine particulate matter, which could apply to nanoparticles
- States could seek to use the fine particulate matter standard as a basis to require air permits
- CAA also regulates the emission of “hazardous air pollutants,” which could include nanoparticles



CWA

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- Any discharge of a “pollutant” into a body of water in the United States (which is broadly defined) requires a permit
- Pollutant could include nanomaterials
- Companies producing nanomaterials could thus be required to obtain a permit for the discharge of nanomaterials



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Other Environmental Laws

NEPA

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- NEPA requires that federal actions that have the potential to impact significantly the environment undertake an analysis of the action's potential impact
- “Federal action” under NEPA has been interpreted to include any action that involves federal funds
- NEPA may require an environmental assessment or an environmental impact statement be prepared and made available to the public



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Other Environmental Laws

State Laws

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- States are free to enact environmental laws that are more stringent than the federal government
- California, for example, could act to regulate nanostructures before EPA
- Other federal agencies, U.S. Food and Drug Administration (FDA) (safety of devices and drugs containing nanotechnology) and the Occupational Safety and Health Administration (OSHA) (workplace safety) may also influence environmental regulation



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EPA Challenges

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- Human health implications of nanotechnology
- Environmental health implications of nanotechnology
- Adequate funding for much needed research
- Workforce training
- Enhanced coordination within EPA and with other government agencies



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EPA Challenges (cont'd)

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- Standardization initiatives
- Harmonizing global initiatives
- Developing appropriate policies and adapting infrastructures
- Managing fast-paced emerging technologies



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EPA Opportunities

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- Working with diverse stakeholders to get it right
- Achieving pollution prevention
- Developing better/smarter remediation technologies
- Improving sensors
- Promoting green manufacturing
- Diminishing/eliminating toxic materials
- Promoting sustainability
- Improving the quality of life



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Useful Nanotechnology Resources

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- EPA's ORD website -- <http://www.epa.gov/ordntrnt/ord/accomplishing/nanotechnology.html>
- NIOSH's nanotechnology website -- <http://www.cdc.gov/niosh/topics/nanotech>
- National Nanotechnology Initiative (NNI) -- <http://www.nano.gov/>
- EPA nanotechnology website -- <http://es.epa.gov/ncer/nano/index.html>



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Useful Nanotechnology Resources (cont'd)

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- Foresight Institute -- <http://www.foresight.org/NanoRev/index.html>
- Nano Science and Technology Institute -- <http://www.nsti.org>
- The EU's Community Research and Development Information System (CORDIS) -- <http://www.cordis.lu/nanotechnology/>
- <http://www.nanotechnologyinstitute.org>
- <http://www.ansi.org>



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Useful Nanotechnology Resources (cont'd)

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- <http://cben.rice.edu>
- <http://www.chemistry.org> (ACS)
- <http://lawbc.com> (B&C Nano)
- <http://www.environmentalfutures.org>
- <http://www.nanoforum.org> (European Nanotechnology Gateway)
- <http://www.hse.gov.uk/research/rrhtm/rr274.htm>
- <http://www.nanouts.edu.au/nanohouse/nanomaterials%20risk.pdf>



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