

Lec9\ Nanotechnology for the Environment

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Nanotechnology

The emerging fields of nanoscience and nanoengineering are leading to unprecedented understanding and control over the fundamental building blocks of all physical things.

The Disadvantages:

Nature of nanoparticles themselves

Characteristics of the products made

Manufacturing processes involved.

The Advantages

Nanotechnology has the potential to substantially benefit environmental quality and sustainability through :

Pollution prevention

Treatment

Remediation

Information

Nanotechnology for pollution prevention

Synthetic or manufacturing processes which can occur at ambient temperature and pressure

Use of non-toxic catalysts with minimal production of resultant pollutants

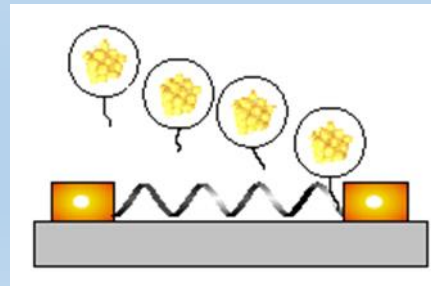
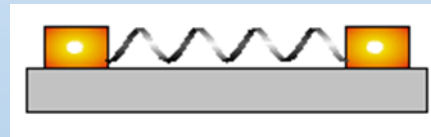
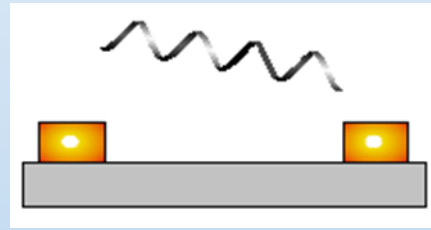
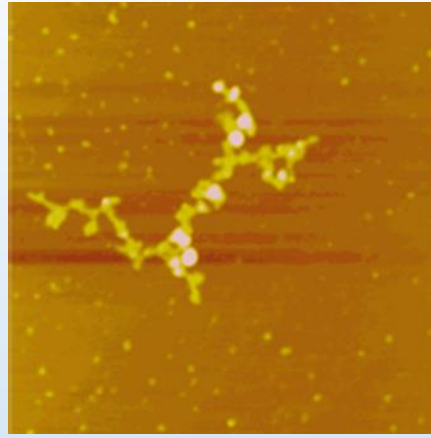
Use of aqueous-based reactions.

Build molecules as needed --“just in time.”

Nanoscale information technologies for product identification and tracking to manage recycling, remanufacture, and end of life disposal of solvents.

Biomolecular nanolithography

- Biomimetic methods of organizing metal particles 1.5 nanometers in diameter
- Assembling the particles on a biopolymer template or scaffold stretched out on a surface
- Nanostructures are organized into well-defined chip architectures, such as lines and grids.
- Process eliminates the current process chemicals that are harmful to the environment.
- Nanoscale assemblies have been made that demonstrate stable, room-temperature electrical behavior that may be tolerant of defects and useful in building nanoscale circuits



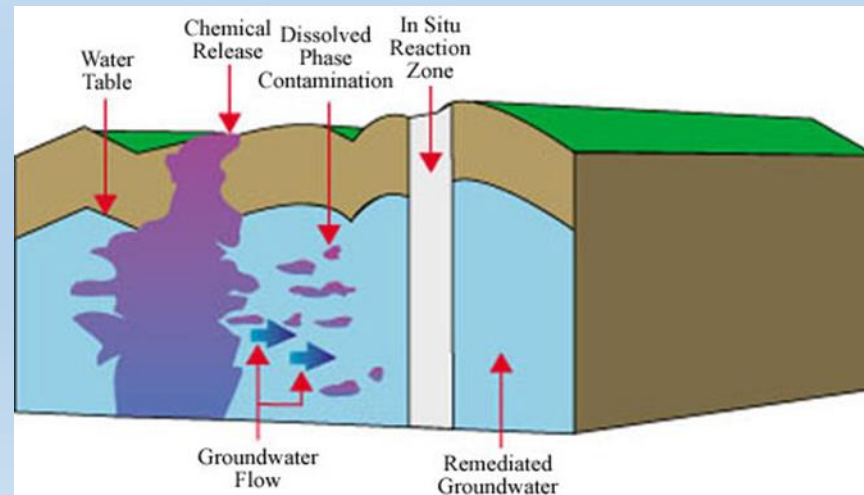
Treatment & Remediation

Iron Treatment Walls...

Used in groundwater treatment for many years.

Iron chemically reduces organic and inorganic environmental contaminants.

Currently involves granular or “microscale” iron ($\approx 50 \mu\text{m}$ or 50,000 nm).



Disease Detection

Nanotechnology

Nanosized iron enhances the reaction. Enhanced further by coupling with other metals (Fe/Pd)* on the nanoscale.

Nano Fe₀ is more reactive and effective than the microscale.

Smaller size makes it more flexible -- penetrates difficult to access areas.

“Sense and Shoot” Approach to Pollution Treatment

- Nanosized zinc oxide (ZnO) “senses” organic pollutants indicated by change in visible emission signal.
- The ZnO “shoots” the pollutants via photocatalytic oxidation to form more environmentally benign compounds.
- Sensing capability means that the energy-consuming oxidation stage only occurs when the pollutants present.
- Multifunctionality and “smartness” is highly desirable for environmental applications.

"Sense and Shoot" Approach to Pollution Treatment

