Where Does The Nano Go? End-of-Life Regulation Of Nanotechnologies

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Why Address Nanotechnology End-of-Life Issues?

- Little is known about effects of nanomaterials and nanowastes on human health or the environment
- Nanomaterials may behave differently in the environment than bulk materials
- No law deals specifically with nanotechnology

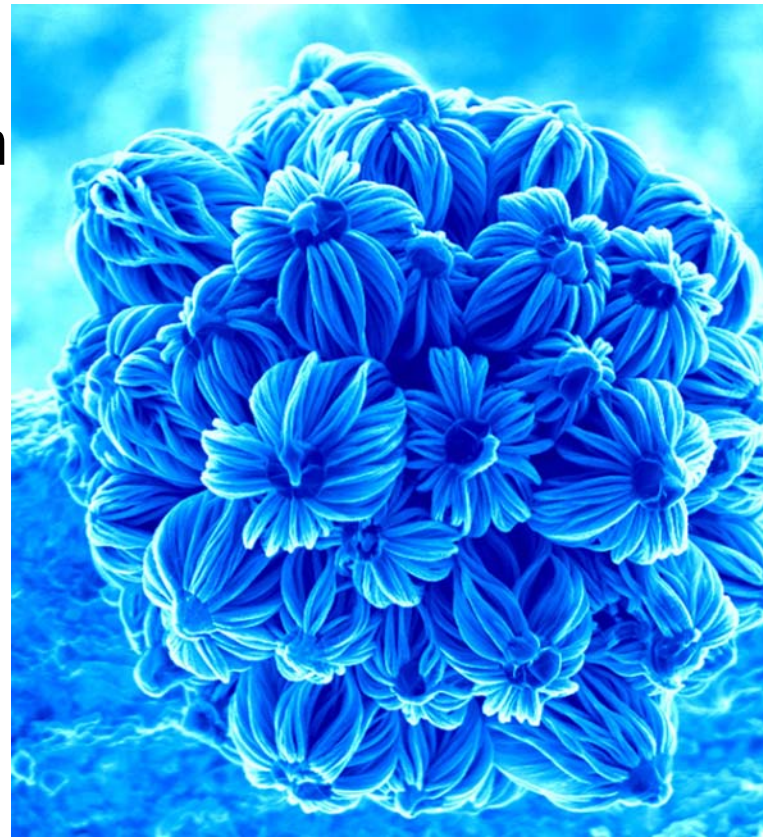


Photo courtesy of Ghim Wei Ho and Prof. Mark Wellar

The Laws: RCRA and CERCLA

- ELI used two hypothetical scenarios to explore how nanowastes could be regulated under two federal laws intended to deal with wastes:
  - Resource Conservation and Recovery Act (RCRA)
    - Regulates handling, reuse, recycling, storage, treatment, and disposal of solid wastes, including hazardous wastes.
  - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or the Superfund law)
    - Addresses hazardous substance contamination and disposal issues not addressed through RCRA and other laws.

Key Issues in Applying RCRA to Nanomaterials

- RCRA
  - Is the substance in question a solid waste?
    - Discarded – abandoned, recycled, or inherently waste-like
  - If so, is the substance a hazardous waste?

Does RCRA Cover Nanowastes?

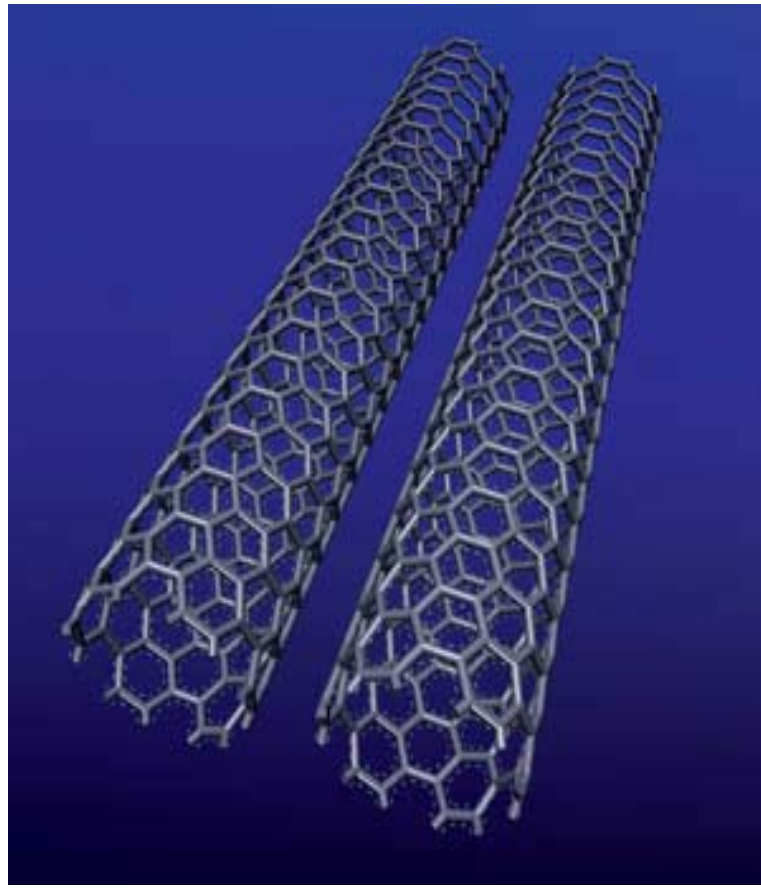
Yes, in theory.

- **Some nanomaterials likely will be classified as hazardous wastes under the existing rules**
- **Listed wastes**
- **Characteristic wastes**
  - **Corrosivity**
  - **Ignitability**
  - **Reactivity**
  - **Toxicity (Toxicity Characteristic Leaching Procedure)**

Does RCRA Cover Nanowastes?

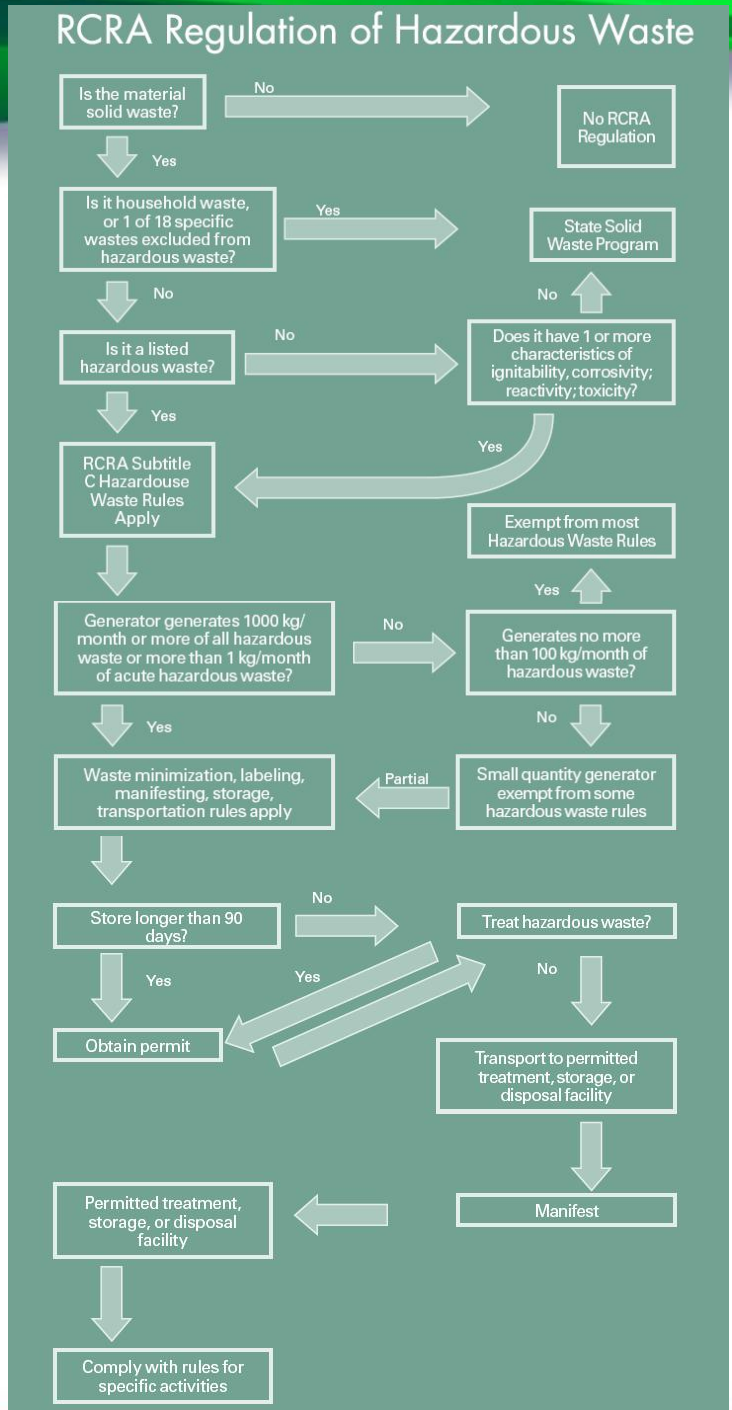
- Generator of a waste is responsible for determining if it is hazardous waste

- Disposal of most consumer products containing nanomaterials will likely be exempt from RCRA as household waste



Nanotubes. Photo courtesy of Friends of the Earth, 2007

RCRA Regulation of Hazardous Waste



Imminent and Substantial Endangerment

- **RCRA authorizes EPA and citizens to sue to remedy conditions where solid or hazardous waste handling, storage, treatment, or disposal have the potential to endanger health or the environment**

  → ***Most likely mechanism for addressing risks associated with nanowastes under existing regulations.***

Conclusions

- Focus of RCRA on mass as a determinant of regulatory coverage may not be appropriate for nanowastes
- Some nanowastes may have different characteristics than the material has in bulk form
- EPA has the authority to list nanowastes as hazardous wastes

Recommendations to EPA: RCRA

- Determine whether specific nanowastes or categories of nanowastes should:
  - be listed as hazardous wastes
  - be classified as acute hazardous wastes
- Review four hazardous waste characteristics
- Review Toxicity Characteristic Leaching Procedure
- Conduct research to determine if existing practices for bulk forms of solid wastes are appropriate for nanoscale wastes of the same chemicals.

Recommendations to Firms: RCRA

- Apply RCRA to nanowastes
- Promote and conduct research into appropriate methods of handling, treating, storing, and disposing of nanowastes

Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)

- Key objectives:
  - Clean up inactive and abandoned hazardous waste sites;
  - Create incentives for proper future handling of hazardous substances.
- Addresses contamination the system failed to address prospectively.
- Nanomaterials also may be used in *site remediation*.

Could the Superfund Statute Apply to Nanomaterials?

Four Key Questions:

1. Is there a **hazardous substance** (or pollutant or contaminant)?
2. Is there a **release** or substantial threat of release?
3. Is the release from a **facility**?
4. Is the release into the **environment**?

Answer:

- Statutory cleanup authorities are general enough to cover nanomaterials;
- Key issue is how EPA assesses and designates nanomaterials under CERCLA and other statutes.

Nanomaterials and CERCLA Liability

- Liability is retroactive, strict, and joint and several for wide range of parties, including:
  - site owners/operators, generators, and transporters; and
  - covers federal facilities.
- Statutory liability approach could:
  - provide authority to require cleanups, if nanomaterials are determined at a later date to be hazardous substances;
  - may influence firm behavior today with respect to handling and disposal of nanomaterials.

Nanomaterials and Superfund Liability Exemptions

- *De minimis* settlements and *de micromis* exemptions consider volume/quantity.
- But exemptions also consider:
  - Toxicity; and
  - Contribution to cleanup/restoration costs.
- Assess over time need for statutory amendments.

Application of Additional Superfund Authorities to Nanomaterials

- Additional CERCLA Authorities:
  - Natural Resource Damages;
  - Enforcement;
  - Cleanup Standards and Remedy Selection; and
  - Cleanup Procedures.
- Authorities all are general enough to apply to nanomaterials.
- Review of regulations, policies, and guidance needed.

Could the CERCLA Release Reporting Requirements Apply to Nanomaterials?

Photo courtesy of BBC news 2007

- Statute requires person in charge of a facility or vessel to notify National Response Center of hazardous substance release.
  - Provided release meets certain threshold quantity.
- EPA sets “reportable quantity.”
  - Default is one pound in most cases.
  - Default quantity may be problematic if applied to nanomaterials.

Conclusions

- Virtually all of the Superfund **statutory** authorities are broad enough in theory to cover nanomaterials.
- Key threshold issue is whether any nanomaterials are or will constitute hazardous substances.
- Highlights importance of how EPA assesses and designates nanomaterials under CERCLA and other statutes.
- Emphasizes critical need for EPA to invest in and encourage human health and eco- toxicity data collection and development.

Superfund-Specific Recommendations

- EPA considerations:
  - Whether any current Superfund hazardous substances are produced in nanoform and, if so, whether these substances also are hazardous; and
  - Whether to use Superfund authority to evaluate nanomaterials as hazardous substances.
- Private firm considerations:
  - Nanomaterials that do not constitute RCRA hazardous waste could be later determined by EPA to be CERCLA hazardous substances;
  - Disposal of nanomaterials could generate liability for cleanup and restoration.

General Recommendations: EPA

- Invest in and encourage development of data on:
  - human health & eco-toxicity; and
  - environmental fate & transport.
- Conduct outreach and education.
- Make decisions about whether and how to apply RCRA and CERCLA to nanomaterials.

Recommendations: Firms

The private sector has responsibilities to assure that nanomaterials and nanowastes are managed safely and in accordance with law

- Promote and conduct research on:
  - human health & eco-toxicity; and
  - environmental fate & transport.

- Recognize that environmental due diligence in commercial transactions and security offerings could examine the handling and disposal of nanomaterials.

Recommendations to Investors and Insurers

Take into account the potential for CERCLA and RCRA liability in

- drafting new insurance policies
- interpreting existing policies
- making lending decisions
- making investments

Clothing treating with nano-scale coating to repel water. Photo courtesy of BBC news 2007

Questions?

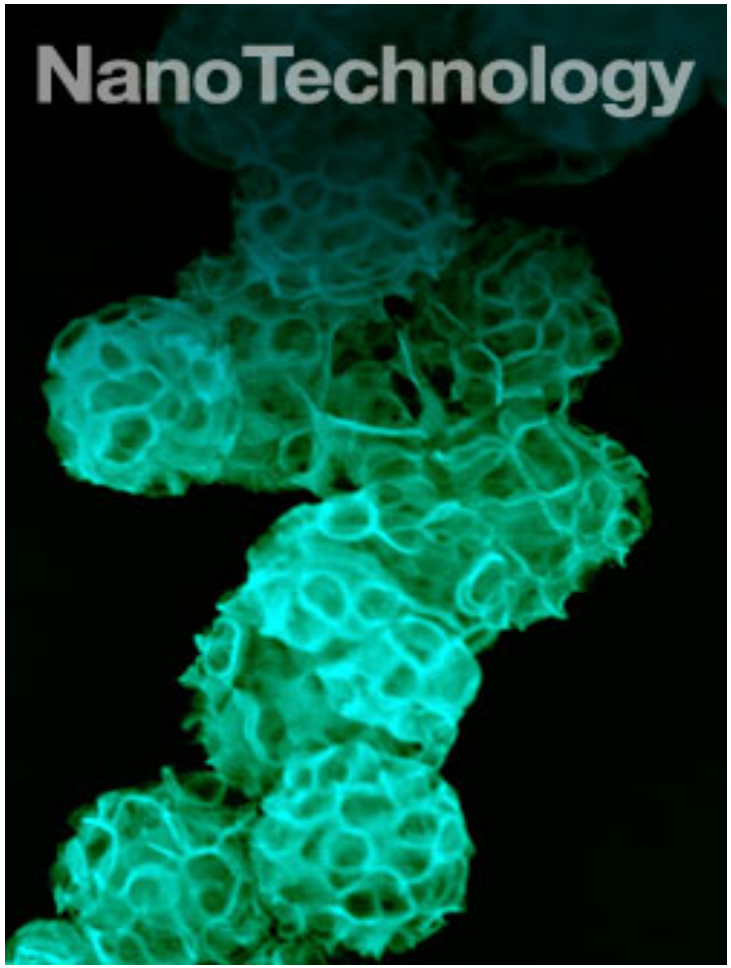


Photo courtesy of **Kanematsu USA Electronics** 2007

Further Information

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