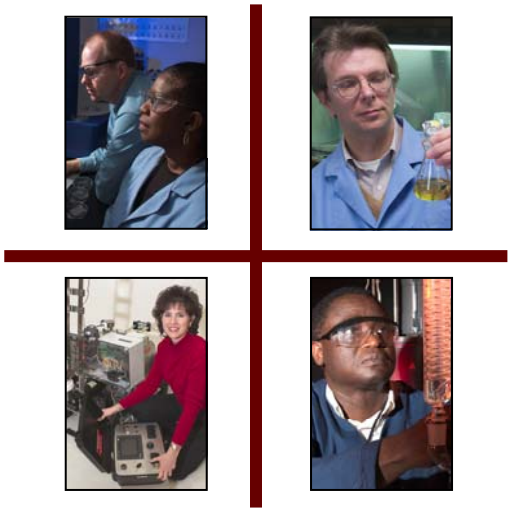
# Generation of Pyrophoric Nanomaterials



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# Introduction

- Nanomaterial Research Drivers
- Nanomaterial Production Methods
- Handling of Standard Pyrophoric Materials-Current Methods
- Handling of Nanoscale Pyrophoric Materials
- Safe Handling of Nanomaterials - Current Efforts
- Summary

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# Nanomaterial Research Drivers

- According to recent EPA white paper, approximately 300 consumer products utilize nanomaterials
- National Nanotechnology Initiative is funded at ~1.5 Billion for 2008
- Constant growth in patent applications for nanotechnology products and materials
- Large funding source for the research community from academia to industry

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# Nanomaterial Production Methods

## Traditional

- Laser Ablation
- Solution Synthesis
- UHV Cluster Synthesis
- Furnace Methods
- Solid State Reactions

## Non-Traditional

- Attritor Milling
- Powder Processing
- Engineering Scale Grinding Operations
- Lithography Operations

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# Nanomaterial Production-Colloids

- Many nanomaterials produced using solution chemistry
  - Present both respiratory and skin absorption hazards
  - Materials coated for colloidal stability should be less hazardous
  - Many materials can also be passivated before handling using a variety of techniques
  - However, should these materials be dried out, they present at least the same hazard as dry metal powders

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# Secondary Nanomaterial Production

- Materials may be produced as a byproduct of other operations
  - Mechanosynthesis
    - Milling of powders
    - Attritors milling of powders
    - Alloying operations
  - Synthesis of unpassivated and secondary nanomaterials
    - Laser ablation techniques
    - Furnace production of carbon nanotubes
    - Template synthesis techniques

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# Standard Handling of Pyrophoric Materials

- Isolate from air/moisture/heat
- Store away from ignition sources
- Always wear appropriate PPE when handling
- The physical hazard can be from the reactivity of the material with other materials or from the from the possibility of “self-ignition”
- Traditional handling methods described above may not adequately address issues posed by handling nanomaterials

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# Handling of Nanoscale Pyrophoric Materials

- Traditionally inert bulk materials may become highly pyrophoric when reduced to a nanoscale (e.g. coal dispersed as a dust)
- Currently, the same GLP used for traditional pyrophoric materials is often used for nanomaterials
- Applicability of current methods is being assessed by a number of organizations
- Most current “standards” apply to toxicology and exposure

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# Safe Handling of Nanomaterials - Current Efforts

- SRNL currently working with ASTM to develop standards to address physical hazards of nanomaterials
- NIOSH/EPA leading efforts in environmental and personnel exposure
- SRNL working to develop methodology for assessment of novel nanomaterial physical hazards
- EU groups working to address concerns with toxicology and environment

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# Summary

- Care must be taken to address the issue of nanomaterials that may be produced as a side product during a variety of non-synthetic processes
- Much waork has been done concerning exposure and toxicology effects
- Physical hazards such as pyrophoricity are beginning to be addressed, but much work must still be done
- SRNL currently working within the ASTM framework to produce standard for nanomaterial physical hazard assessment

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