Understanding Occupational Safety and Health Issues of Nanotechnology: A Progress Report

Paul A. Schulte, Ph.D.
National Institute for Occupational Safety and Health
Centers for Disease Control and Prevention

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.
Progress Toward Safe Nanotechnology in the Workplace
A Report from the NIOSH Nanotechnology Research Center

- Research progress in 10 key areas
- Continuing project plans
- Opportunities for collaboration

www.cdc.gov/niosh/topics/nanotech
Steps to Protect Nanotechnology Workers

Hazard Identification
“Is there reason to believe this could be harmful?”

Exposure Assessment
“Will there be exposure in real-world conditions?”

Risk Characterization
“Is substance hazardous and will there be exposure?”

Risk Management
“Develop procedures to minimize exposures”

Adapted from Gibbs, 2006
# Hazard Identification

## What we know
- Health effects from industrial ultrafines, fibers, and air pollution
- Some single walled carbon nanotubes caused fibrosis in mice lungs
- Cardiovascular response from SWCNT and TiO$_2$
- SWCNT effects on skin cells
- Some explosive, reactivity, and flammability potential

## What we don’t know
- Applicability to engineered nanoparticles
- Nature and severity of effects on lungs
- Extent of movement to other parts of the body
- What properties of nanoparticles influence how the body responds
- Extent of skin absorption
- Extent of explosivity, reactivity, and flammability
# Exposure Assessment

<table>
<thead>
<tr>
<th><strong>What we know</strong></th>
<th><strong>What we don’t know</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanoparticles can be measured</td>
<td>What are the best measures</td>
</tr>
<tr>
<td>Engineered nanoparticles can get into workplace air</td>
<td>What is the extent of exposure</td>
</tr>
<tr>
<td>Specific tasks may increase risk of exposure</td>
<td>Sampling techniques not readily applicable</td>
</tr>
<tr>
<td>Maintenance work can result in skin and inhalation exposure</td>
<td>Personal breathing zone monitoring techniques need development</td>
</tr>
</tbody>
</table>
## Risk Characterization

<table>
<thead>
<tr>
<th>What we know</th>
<th>What we don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater risk from nanoparticles on a mass basis than larger particles of the same material</td>
<td>What are the risks the beyond experimentally characterized range</td>
</tr>
<tr>
<td>Animal models can describe human risks</td>
<td>How chemical and physical factors influence risk</td>
</tr>
<tr>
<td>Using animal data on ultrafines: lifetime risks to workers at current OELs may be &gt;1/1000</td>
<td>Exposure-response relationships for most nanoparticles</td>
</tr>
<tr>
<td></td>
<td>Long term health effects</td>
</tr>
</tbody>
</table>
## Risk Management

### What we know
- Airborne exposure to nanoparticles can be controlled
- Good work practices can minimize exposures
- Respirators should be effective
- Current macroscale OELs are probably not protective at the nanoscale

### What we don’t know
- Limits of controls
- No appropriate OELs specifically for engineered nanoparticles
- Limits of respirators and PPE
- Focus for medical surveillance
What would additional funding enable NIOSH to do:

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess more nanoparticles for toxicity</td>
<td>$2 million/yr</td>
</tr>
<tr>
<td>Conduct more field visits to assess nanoparticle exposure</td>
<td>$1 million/yr</td>
</tr>
<tr>
<td>Conduct a broader range of control technology and PPE research</td>
<td>$2 million/yr</td>
</tr>
<tr>
<td>Conduct molecular epidemiologic studies of nanotechnology workers</td>
<td>$3 million/yr</td>
</tr>
<tr>
<td>Initiate research on applications of nanotechnology to occupational safety and health</td>
<td>$1 million/yr</td>
</tr>
</tbody>
</table>

Total $10 million/yr
Thank You

www.cdc.gov/niosh/topics/nanotech