NANOMATERIALS IN THE WORKPLACE

NIOSH EXPOSURE ASSESSMENT TECHNIQUE 2.0

PRESENTED BY SKC

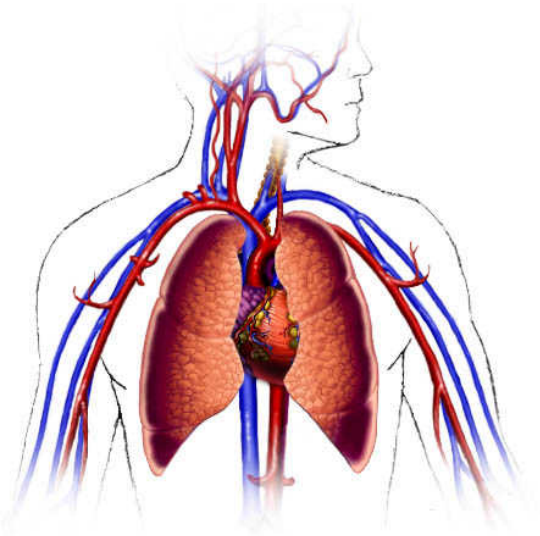
INTRODUCTORY NOTES

- Nano-sized particles have *at least one dimension* between 1 and 100 nanometers (0.001-0.1 microns).
- Found in a variety of shapes including quantum dots, nanofibers, nanotubes, and nanobelts.

NANOPARTICLES:
SUMMARY OF HEALTH RISKS

- **GREATER BIOREACTIVITY**
  due to larger surface area

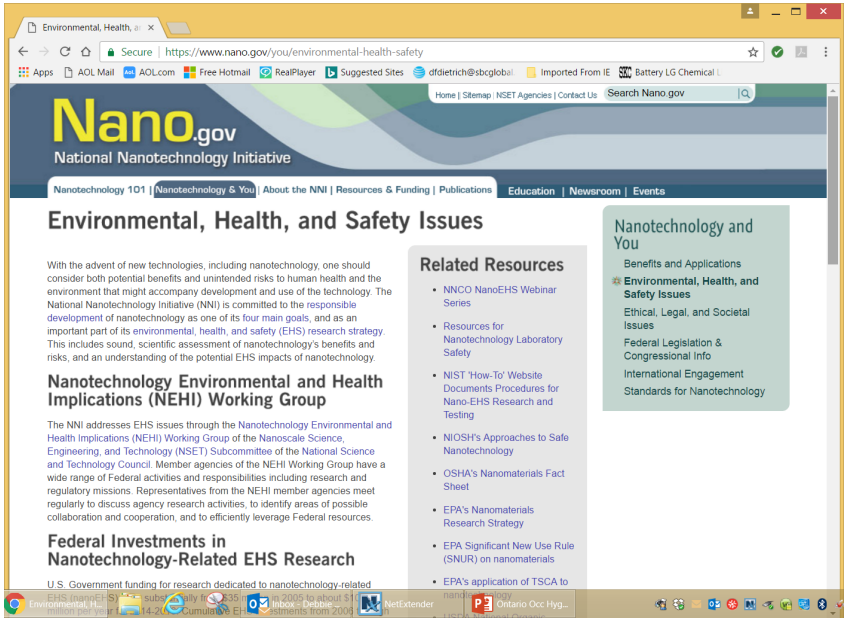
- **GREATER MOBILITY IN THE BODY**
  due to smaller size



NANOPARTICLES:
A GROWING CONCERN

- Engineered nanomaterials (ENMs) represent an INDUSTRIAL REVOLUTION. They are being used in consumer and commercial products across all industry sectors.
- NIOSH stated: “Increasingly, workers are involved not only in production of the ENMs, but in use, recycling, and disposal of ENMs or products containing ENMs.”

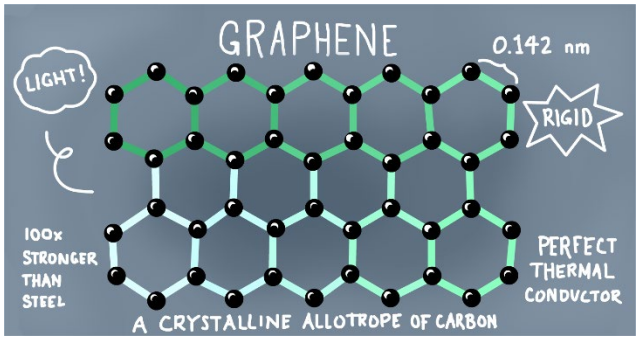
NATIONAL NANOTECHNOLOGY INITIATIVE IN THE U.S.

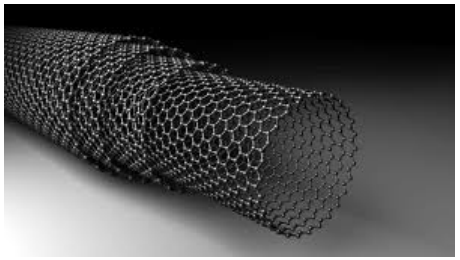


A government research and development initiative involving 20 departments and independent agencies including NIOSH and OSHA working together toward the shared vision of *"a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society."*

BASIC SCIENCE OF
CARBON NANOTUBES

- Carbon nanotubes are cylinders of one or more layers of GRAPHENE.
- Graphene is an “allotrope” of carbon consisting of a tightly packed layer of carbon atoms bonded together in a hexagonal honeycomb lattice.
- Graphene can be used to make single or multi-wall carbon nanotubes.





CARBON NANOTUBES
MAY REVOLUTIONALIZE OUR WORLD

- Can produce materials with strength unmatched by anything currently in use.
- Could replace power grid due to large current carrying capacity and replace current batteries and solar panels due to high energy storage capabilities.
- Can be used to enhance the properties of many materials such as paints/coatings and be used as flame retardants, biocides, and anti-corrosion agents.

CARBON NANOTUBES
THE HEALTH RISKS

- NIOSH publications note concerns that MULTI-WALL carbon nanotubes may produce similar health effects to that of asbestos. (Single-wall are not as hazardous).
- A February 2017 AIHA *Synergist* article reported that cytotoxic and genotoxic effects have been demonstrated following exposure to engineered nanomaterials including cardiovascular and pulmonary inflammation and fibrosis.

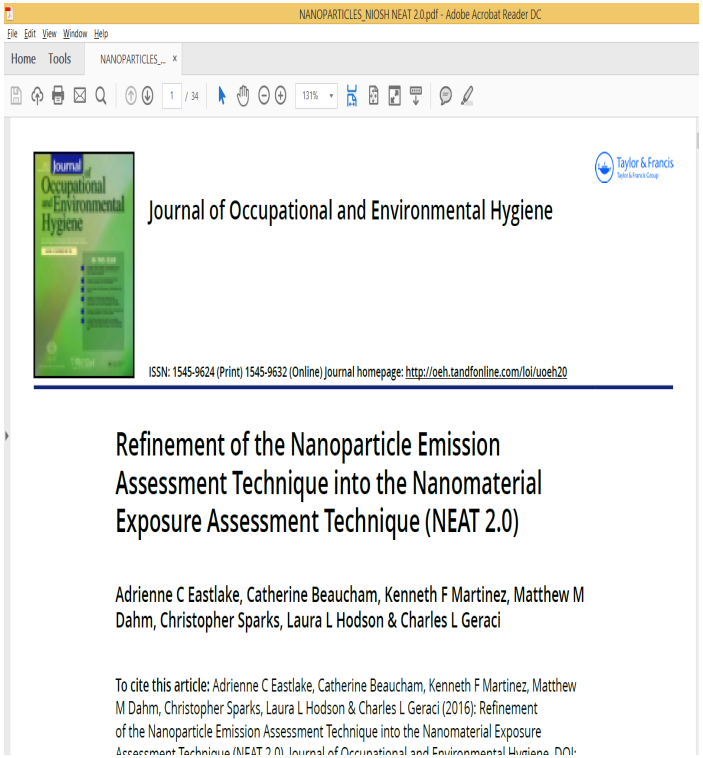
THERE ARE NANOS
IN YOUR WORKPLACE!

Incidental nano-sized particles (ultrafines) can be generated from typical workplace sources:

- Combustion sources such as vehicle emissions and welding
- Even desktop 3D printers are high emitters of ultra-fine i.e. nano-sized particles (*Atmospheric Environment,* 79, 2013).

NIOSH UPDATE ON SAMPLING OF NANOMATERIALS

- In March 2016, NIOSH published a refinement to their 2009 publication of the NANOMATERIAL EXPOSURE ASSESSMENT TECHNIQUE (NEAT).



NANOPARTICLES_NIOSH NEAT 2.0.pdf - Adobe Acrobat Reader DC

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Refinement of the Nanoparticle Emission Assessment Technique into the Nanomaterial Exposure Assessment Technique (NEAT 2.0)

Adrienne C Eastlake, Catherine Beaucham, Kenneth F Martinez, Matthew M Dahm, Christopher Sparks, Laura L Hodson & Charles L Geraci

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NEAT 2.0

Takes standard IH strategies, collection media, and sampling methods in a new direction for new types of hazards:

1. Filter samples with lab analysis for full-shift and short-term personal and area samples.
2. Particle counters in data-logging mode to monitor peaks and transient changes in nanoparticle levels.

FILTER-BASED SAMPLES:
GENERAL APPROACH

TWO SIMULTANEOUS OPEN-FACE 25-MM FILTER SAMPLES are collected for both area and on-worker assessments FOLLOWING STANDARD NIOSH METHODS:

- One filter sample is used for chemical analysis of elemental mass such as elemental carbon.
- The other filter is used for electron microscopic analysis of particle size, shape, and identification.

SPECIFICS ON FILTER SAMPLING FOR NANOMATERIALS WITH A NIOSH REL

REL of 1 ug/m^3 for carbon nanotubes and nanofibers

- A respirable dust sampler is used with a 25-mm quartz filter for analysis of elemental carbon by NIOSH Method 5040.
- A second sample using an open-face 25-mm MCE filter is used for electron microscopy.

SPECIFICS ON FILTER SAMPLING FOR NANOMATERIALS WITH A NIOSH REL

REL of 300 ug/m^3 for nanosized titanium dioxide

- A respirable dust sampler is used with a 25-mm PVC filter for gravimetric analysis by NIOSH Method 0600.
- If over the REL using gravimetric analysis, a 25-mm MCE or PVC filter is used for elemental analysis by NIOSH Method 7300.
- Another sample is collected using an open-face 25-mm MCE filter for electron microscopy.

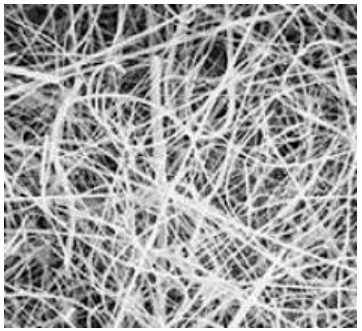
FREQUENT QUESTION:

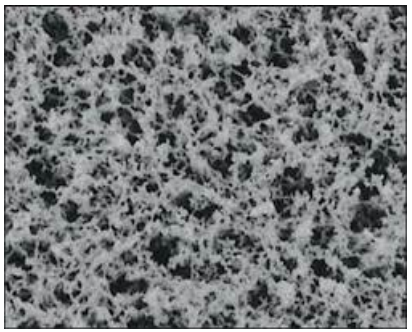
GIVEN THE PORE SIZE, CAN STANDARD IH FILTERS BE USED TO TRAP NANOPARTICLES?

NIOSH answers YES to this question. “The pore size of a filter does NOT indicate the size of the airborne particles that the filter will collect. The STRUCTURE of the filter has a much greater effect on the collection characteristics.”

MORE ON FILTER PORE SIZE

- Fibrous and porous membrane filters do not have well-defined pores that act like a sieve.
- Instead, particles collected onto these filters are forced to follow a meandering, tortuous path which increases the likelihood that particles are collected via impaction, interception, and other mechanisms.





NIOSH CHAPTER ON FILTERS
IN 5TH EDITION METHOD MANUAL

- Filter Pore Size and Aerosol Sample Collection by William G. Lindsley, PhD, NIOSH

- Discussion includes:
  -Physical structures of filters
  -Determination of equivalent pore diameter
  -How an aerosol filter collect particles
  -Aerosol filter efficiency and pore size
  -Significance of pore size
  -Filter selection

THANK YOU
FOR YOUR INTEREST

- Please contact your local SKC representative for further information on sampling products for nanomaterials.
- Visit the SKC website at www.skcinc.com for more training options.
- Email skctech@skcinc.com with technical questions.