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"Why am I muted?"
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https://www.acs.org/content/acs/en/acs-webinars/videos.html

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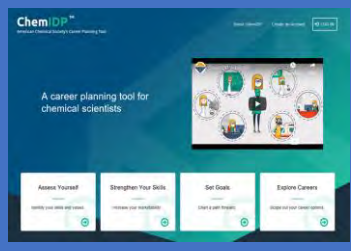

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Professional Education


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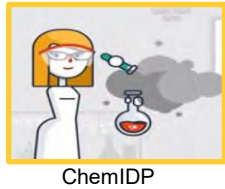
Career Navigator LIVE!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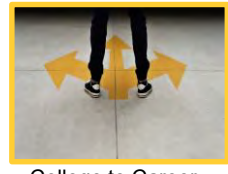
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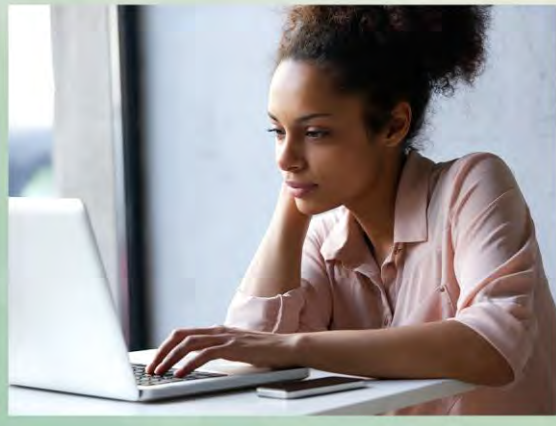

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A Career Planning Tool For Chemical Scientists

ChemIDP is an Individual Development Plan designed specifically for graduate students and postdoctoral scholars in the chemical sciences. Through immersive, self-paced activities, users explore potential careers, determine specific skills needed for success, and develop plans to achieve professional goals. **ChemIDP** tracks user progress and input, providing tips and strategies to complete goals and guide career exploration.

https://chemidp.acs.org

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ACS Department of Diversity Programs

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We believe in the strength of diversity in all its forms, because inclusion of and respect for diverse people, experiences, and ideas lead to superior solutions to world challenges and advances chemistry as a global, multidisciplinary science.

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ACS Diversity

ACS Voices Diversity Podcast

acsvoices.podbean.com/

www.acs.org/diversity

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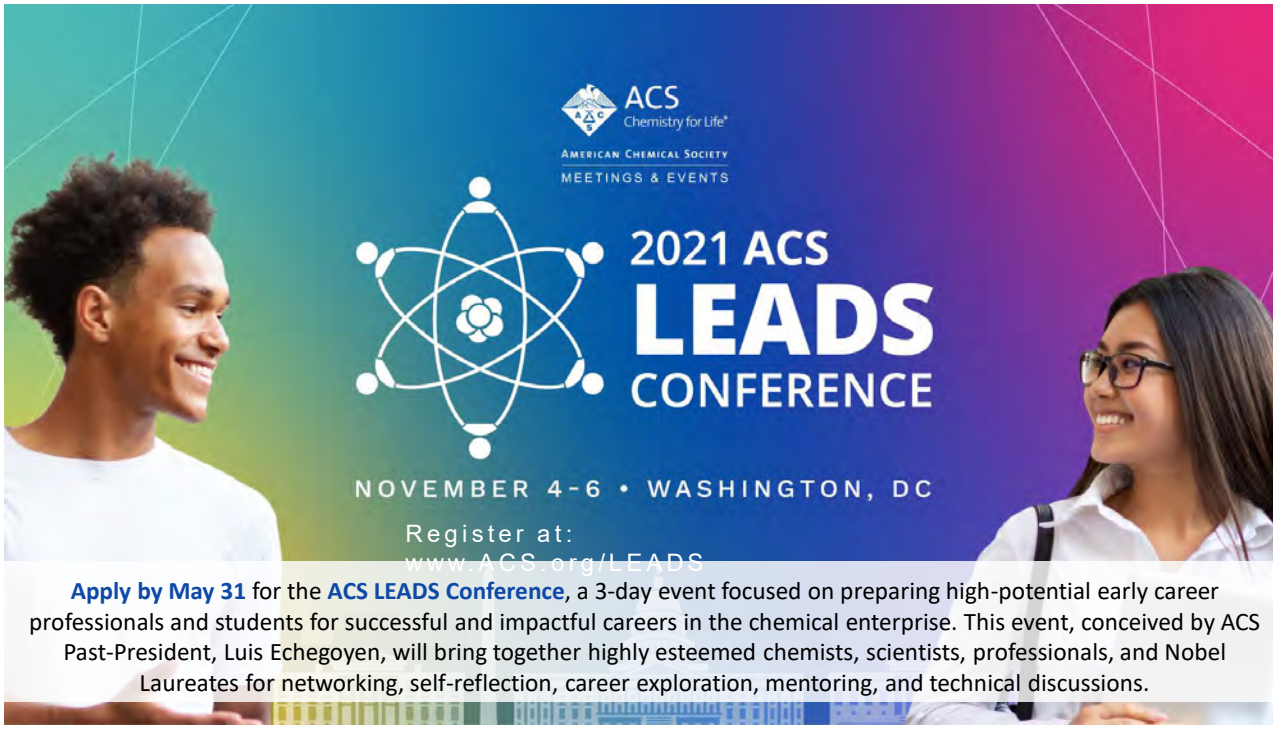

Apply by May 31 for the **ACS LEADS Conference**, a 3-day event focused on preparing high-potential early career professionals and students for successful and impactful careers in the chemical enterprise. This event, conceived by ACS Past-President, Luis Echegoyen, will bring together highly esteemed chemists, scientists, professionals, and Nobel Laureates for networking, self-reflection, career exploration, mentoring, and technical discussions.

ACS CHAS

Empowering academic researchers to strengthen safety culture

ACS Technical Division
Chemical Health & Safety (CHAS)

Saturday, June 5, 2021 from 2PM – 6PM ET

The workshop is $25 per participant.

This **4-hour workshop** is primarily directed at frontline researchers in academic institutions: **graduate students, postdoctoral scholars, and undergraduate students**. Faculty and safety staff are also very much encouraged to participate.

Workshop Goals:

- Educate participants about the value of risk assessment
- Guide participants towards gaining awareness of safety culture messages from leadership at their institutions
- Empower participants to expand their safety networks and develop laboratory safety teams

https://dchas.org

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Date: Tuesday, May 18, 2021 @ 2-3pm ET
Speaker: Xiaoxing Xi, Temple University
Moderator: Jyllian Kemsley, *Chemical & Engineering News*

Register for Free!

What You Will Learn:

- A personal account of what occurs when the DOJ charges someone for stealing secrets
- Why criminal investigations and prosecutions under the DOJ's "China initiative" are unjust to Chinese scientists and damaging to American leadership in science and technology
- Why open fundamental research is facing an existential threat and what a federal scientific group recommends to address China influence within the framework of research integrity

Co-produced with: *Chemical & Engineering News*

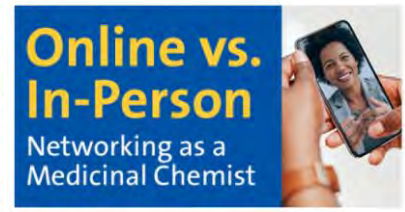
Date: Wednesday, May 19, 2021 @ 6-7 IST (8:30am ET)
Speaker: Amitabha Bandyopadhyay, Indian Institute of Technology Kanpur
Moderator: Deeksha Gupta, American Chemical Society

Register for Free!

What You Will Learn:

- What are the key ingredients of a successful start-up
- How to develop a refined approach to finding a relevant problem to solve
- How to master the art of defining the customer segment in a start-up culture

Co-produced with: ACS International, catering to an audience based in India



Date: Thursday, May 20, 2021 @ 2-3:30pm ET
Speakers: Ronny Priefer, Massachusetts College of Pharmacy and Health Sciences / Kelly Chibale, University of Cape Town (South Africa) / Maria Laura Bolognesi, University of Bologna (Italy)
Moderator: Lorraine Clark, ACS Publications

Register for Free!

What You Will Learn:

- Why networking is essential for a successful career in medicinal chemistry
- How to approach in-person vs. virtual networking with proven advice from leaders in the field
- What tips and tricks for virtual networking provide results and how you can get started now

Co-produced with: ACS Divisions of Medicinal Chemistry Chemical Toxicology, American Association of Pharmaceutical Scientists, and ACS Publications

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ACS Chemistry for Life®

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ACS Committee Chemical Safety

Nanosafety

Emerging Research Perspectives

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ACS Chemistry for Life®

Nanosafety: Emerging Research Perspectives

MARKUS SCHAUFELE
Research Safety Manager, Northwestern University

TILAK CHANDRA
Chemical Safety Specialist, University of Wisconsin-Madison

KATIE KRUSZYNSKI
Graduate Student, University of Wisconsin-Madison

RALPH STUART
Environmental Safety Manager, Keene State College and Chair, ACS Committee on Chemical Safety

Presentation slides are available now! The edited recording will be made available as soon as possible.

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This ACS Webinar is co-produced with ACS Division of Chemical Health and Safety ACS Committee on Chemical Safety.

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Northwestern | RESEARCH

nano safety

16

promise, risk, benefit and uncertainty

17

"Nano" Safety

Use of the term **"nano"** is optional and voluntary.

There are no regulatory **"nano"** identification or labeling requirements for materials or wastes.

Including **"nano"** on a hazard label or Safety Data Sheet is voluntary.

Nanotoxicology perspective

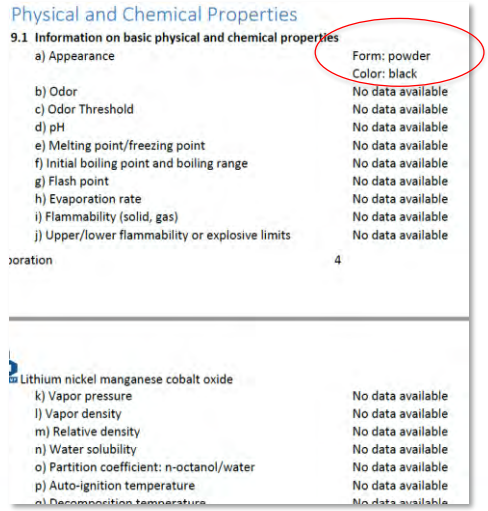
... currently no indications that **nano** materials will lead to other environmental or health effects (i.e. new toxicological endpoints or diseases) than those known for non-nanomaterials.

… challenge of getting null results published

Sources: Donaldson and Poland, Nanotoxicity: challenging the myth of nano-specific toxicity, Curr. Opin. Biotechnol., 24 (2013), pp. 724-734;
Gebel et al. Manufactured nanomaterials: categorization and approaches to hazard assessment Arch. Toxicol., 88 (2014), pp. 2191-2211;
Nel et al., Toxic potential of materials at the nanolevel, Science, 311 (2006), pp. 622-627); Steve Oldenburg, Nanosafety: Conclusions From a Decade of Nanotoxicology Research (2017)

Northwestern Research Safety

Safety Data (?) Sheet (SDS)



Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: powder Color: black
b) Odor	No data available
c) Odor Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available

oration 4

Lithium nickel manganese cobalt oxide

k) Vapor pressure	No data available
l) Vapor density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available

TSCA Chemical Inventory

41,864 registered substances active in U.S commerce (2021)

The term **“nano”** does not appear.

TSCA registry exemptions include: low volume, low release and exposure, test marketing, research and development substances

Source: Toxic Substances Control Act (TSCA) Chemical Substance Inventory https://www.epa.gov/tsca-inventory

UN Global Harmonization (GHS)

Safety Data Sheet Section 9: Physical and Chemical Properties

	***NOTE**: For clarity, the SDS should indicate if absolute density (indicate units) and/or relative density (no units) is being reported.*
Relative vapour density	– applicable to gases and liquids only – for gases, indicate the relative density of the gas based on air at 20 °C as reference (=*MW*/29) – for liquids, indicate the relative vapour density based on air at 20 °C as reference (=*MW*/29) – for liquids, the relative density of the vapour/air-mixture at 20 °C (air = 1) may be indicated in addition. It can be calculated as follows: $D_m = 1 + (34 \cdot VP_{20} \cdot 10^{-6} \cdot (MW - 29))$ where • D_m is the relative density of the vapour/air mixture at 20 °C • VP_{20} is the vapour pressure at 20 °C in mbar • *MW* is the molecular weight
Particle characteristics	– applicable to solids only – indicate the particle size (median and range) – if available and appropriate, further properties may be indicated in addition, e.g. • size distribution (range) • shape and aspect ratio • specific surface area

Source: UNECE GHS (Rev.7) (2017) Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

SDS Section 9 "Nano"

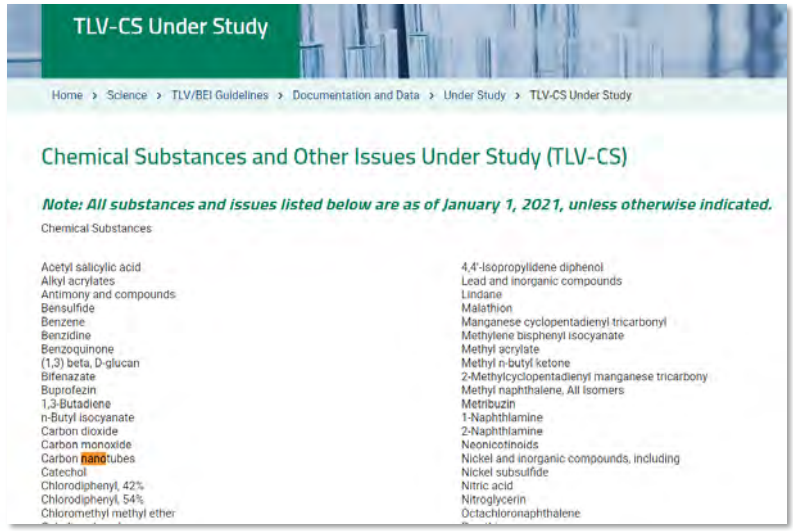
SECTION 9: Physical and Chemical Properties

FORM:	Powder, individual particles 5-150 nm total diameter.
APPEARANCE/COLOR:	Light/dark brown, brown/gray powder, flaky.
UPPER/LOWER FLAMMABILITY LIMIT:	No data available.
ODOR:	No data available.
VAPOR PRESSURE:	No data available.

Dynamic viscosity	No data available
Particle characteristics	
Particle Size	No information available
Particle Size Distribution	No information available
Explosive properties	No information available

Source: https://nanocomposix.com/#target, Pfizer-BioNTech COVID-19 Vaccine

ACGIH "Nano"



TLV-CS Under Study

Home › Science › TLV/BEI Guidelines › Documentation and Data › Under Study › TLV-CS Under Study

Chemical Substances and Other Issues Under Study (TLV-CS)

Note: All substances and issues listed below are as of January 1, 2021, unless otherwise indicated.

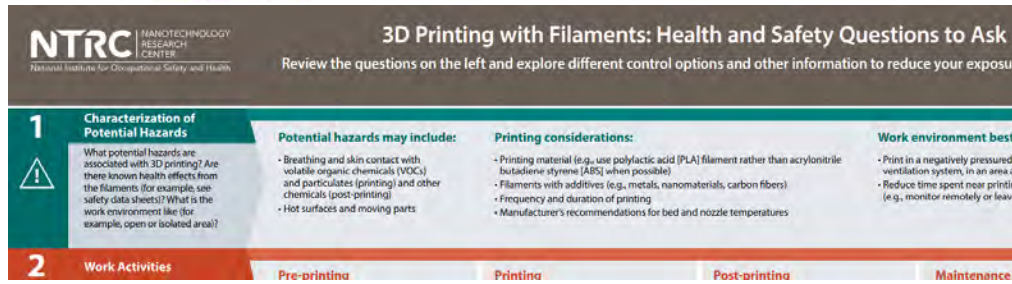
Chemical Substances

Acetyl salicylic acid
Alkyl acrylates
Antimony and compounds
Bensulfide
Benzene
Benzidine
Benzoquinone
(1,3) beta, D-glucan
Bifenazate
Buprofezin
1,3-Butadiene
n-Butyl isocyanate
Carbon dioxide
Carbon monoxide
Carbon nanotubes
Catechol
Chlorodiphenyl, 42%
Chlorodiphenyl, 54%
Chloromethyl methyl ether

4,4'-Isopropylidene diphenol
Lead and inorganic compounds
Lindane
Malathion
Manganese cyclopentadienyl tricarbonyl
Methylene bisphenyl isocyanate
Methyl acrylate
Methyl n-butyl ketone
2-Methylcyclopentadienyl manganese tricarbony
Methyl naphthalene, All isomers
Metribuzin
1-Naphthlamine
2-Naphthlamine
Neonicotinoids
Nickel and inorganic compounds, including
Nickel subsulfide
Nitric acid
Nitroglycerin
Octachloronaphthalene

Source: American Conference of Governmental Industrial Hygienists (ACGIH®) https://www.acgih.org/about/

NIOSH (2020)



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National Institute for Occupational Safety and Health

3D Printing with Filaments: Health and Safety Questions to Ask

Review the questions on the left and explore different control options and other information to reduce your exposure

1 Characterization of Potential Hazards

What potential hazards are associated with 3D printing? Are there known health effects from the filaments (for example, see safety data sheets)? What is the work environment like (for example, open or isolated area)?

Potential hazards may include:
- Breathing and skin contact with volatile organic chemicals (VOCs) and particulates (printing) and other chemicals (post-printing)
- Hot surfaces and moving parts

Printing considerations:
- Printing material (e.g., use polylactic acid [PLA] filament rather than acrylonitrile butadiene styrene [ABS] when possible)
- Filaments with additives (e.g., metals, nanomaterials, carbon fibers)
- Frequency and duration of printing
- Manufacturer's recommendations for bed and nozzle temperatures

Work environment best p
- Print in a negatively pressured a ventilation system, in an area aw
- Reduce time spent near printing (e.g., monitor remotely or leave

2 Work Activities

Pre-printing | Printing | Post-printing | Maintenance a

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National Institute for Occupational Safety and Health

3D Printing with Metal Powders: Health and Safety Questions to Ask

Review the questions on the left and explore different control options and other information to reduce your exposure on the right.

1 Characterization of Potential Hazards

What potential hazards are associated with metal powder 3D printing? What metals are in the powder? Are there known health effects from the metals (see safety data sheets) or can they be reactive with the air? What is the work environment like (for example, an open or isolated area)?

Potential hazards may include:
- Breathing and skin contact with metals
- Static, fire and explosion
- High powered lasers

Printing considerations:
- Printer locations
- Grounding and bonding straps used when removing filters
- Written procedures covering receiving and disposal of metal powders, operation and maintenance activities

Work environment best practices:
- Print in a negatively pressured area with a dedicated ventilation system, in an area away from other work
- Appropriate fire suppression system

2 Work Activities

Could the work activities cause exposure? How are you handling the metal powders? What is the likelihood

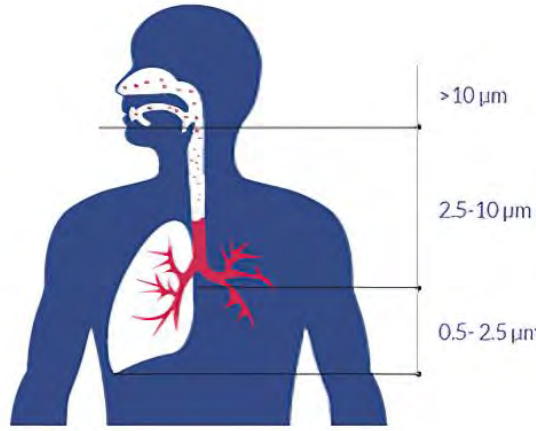
Pre-printing
Higher potential for exposures:
- Loading powders manually into machine
- Sieving powder outside of machine

Printing
Higher potential for exposures:
- Other work activities nearby

Post-printing
Higher potential for exposures:
- Removing powder or printed object from printer
- Moving powder/printed object around

Maintenance and cleaning
Higher potential for exposures:
- Performing preventative maintenance on printer

Inhalable Particles



Northwestern University - Three campuses
240-acre campus in Evanston, 25-acre campus in Chicago, campus in Qatar
12 schools and colleges
21,000 students
- 8,000 full-time undergraduates
- 8,000 full-time graduate students

3,300 full-time faculty members
Annual budget: > $2.5 billion almost $900 million in sponsored research

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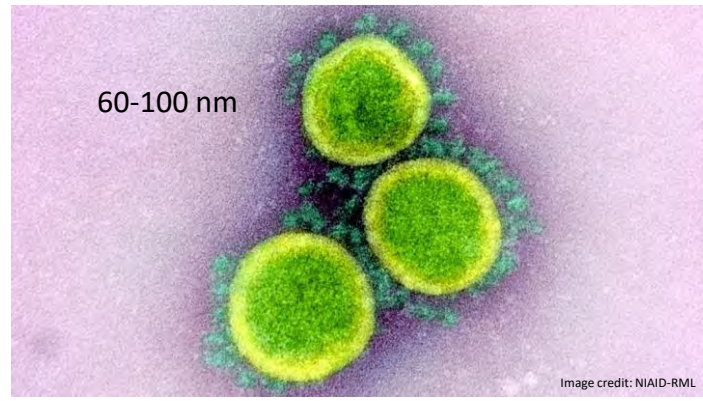
(Nano)particle

Size (1-100 nm)
Composition
Morphology
Surface charge
Surface coating
Band gap
Catalytic properties
Plasmonic properties
Phase stability
Defects
Instability



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New Spherical Nucleic Acid 'Drug' Kills Tumor Cells in Humans With Glioblastoma

BY MARLA PAUL ON MAR 10, 2021

Listen to an episode of the Breakthroughs Podcast on this research:

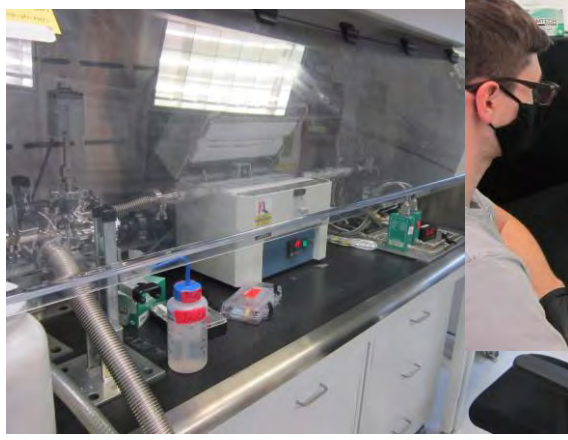
BREAKTHROUGHS
Northwestern Drug Kills Glioblastoma Tumor Cells with Priya K...

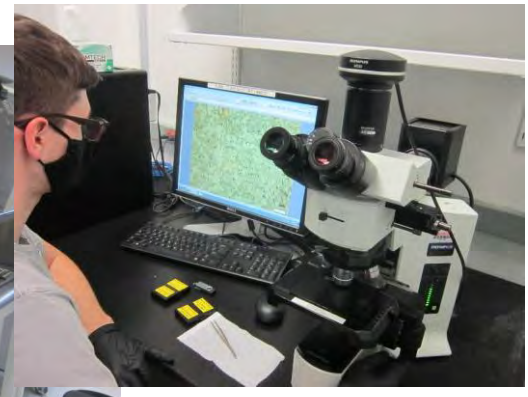
Early clinical trial shows experimental drug crosses blood-brain barrier to trigger death of brain tumor cells

An early clinical trial in individuals with the deadly brain cancer, glioblastoma, showed an experimental spherical nucleic acid (SNA) drug developed by Northwestern University scientists was able to penetrate the blood-brain barrier and trigger the death of tumor cells.

This study, published in *Science Translational Medicine*, is the first time a nanotherapeutic has been shown to cross the blood-brain

Thin Film Deposition





2D Molybdenum disulfide

3-D Printing – Metal Powders

Wet separator

Northwestern Research Safety

Traditional laboratory engineering controls prevail.

Methods to identify deviations from safe laboratory practices remain traditional.

Identified inorganic **“nano”** wastes from research laboratories are specially handled. Most **“nano”** wastes are routed for thermal destruction.

Conclusion

- The term **“nano”** can be useful in nuanced safety contexts
- Safety information for nano-scale substances may omit the term **“nano”**
- Discoveries of novel benefits are advancing faster than discoveries of novel risks
- Nanotoxicology results have been reassuring
- Traditional chemical hygiene practices remain the standard for safety in research

Sources

- Steve Oldenburg, **Nanosafety: Conclusions From a Decade of Nanotoxicology Research**, nanoComposix, (2017) https://www.youtube.com/watch?v=X-HiWAjqYgg
- **Nanotechnology**, National Institute for Occupational Safety and Health (NIOSH) [Centers for Disease Control and Prevention] https://www.cdc.gov/niosh/topics/nanotech/default.html
  - 3D Printing with Filaments: Health and Safety Questions to Ask (2020)
  - 3D Printing with Metal Powders: Health and Safety Q. to Ask (2020)
  - Continuing to Protect the Nanotechnology Workforce: NIOSH Nanotechnology Research Plan for 2018 – 2025
- Dekkers, Susan et al; **Safe-by-Design part I: Proposal for nanospecific human health safety aspects needed along the innovation process**, NanoImpact, Volume 18, April 2020
- Janeck J.Scott-Fordsmand et al, **A unified framework for nanosafety is needed**, Nano Today, Vol 9, I5, 2014, Pages 546-549 https://www.sciencedirect.com/science/article/pii/S1748013214001030

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT

Which of these issues related to research activities with engineered nanoparticles are your GREATEST concern:

- Uncertainties about the effectiveness of exposure control technologies
- Uncertainties about exposure routes or toxicity thresholds
- Uncertainties about the impact of environmental releases
- Uncertainties in funding the safe operation of research
- Uncertainties related to ethical, equity or moral issues

** If your answer differs greatly from the choices above tell us in the chat!*

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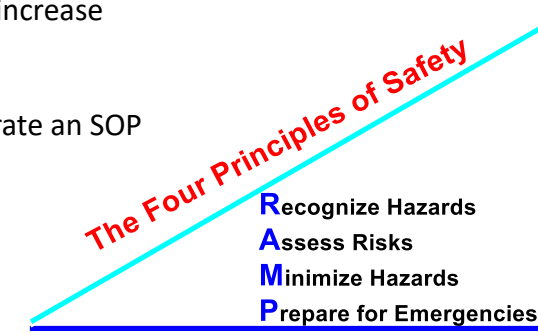
Nanomaterial Safe Work Practices: Potential Safety Hazards, Hazard Assessment & SOP Development

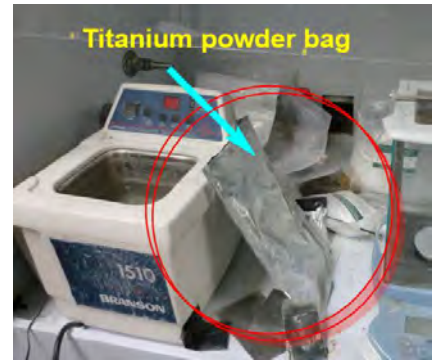
- Enhanced hazards (and risks). Increased fire, explosion risk, enhanced reactivity (there is the potential for lower energetic or catalytic thresholds) – and maybe increase health hazards
- A proper hazard assessment is needed to generate an SOP tailored specific to the procedure.



https://www.acs.org/content/acs/en/chemical-safety/basics.html
Hill, R. H., Jr.; Finster, D. C. Laboratory Safety for Chemistry Students; Wiley, Hoboken, NJ, 2010.

A Titanium Nanomaterial (30-50 nm) Powder Fire

Lessons Learned: Housekeeping, training, safety documents, emergency procedures.



- The fire started in the opened original packaging containing 50 g. of titanium powder (30-50 nm in size) during a transfer
- The researcher was NOT trained on emergency procedure & inadequate HA
- An SOP was available in the lab; however, it was not accessible to the researcher.

Safety Checklist: Nanomaterial Manipulations

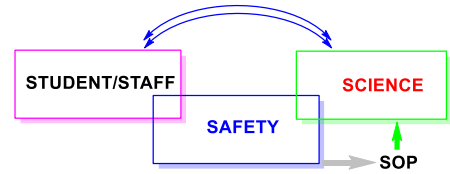
Items	Y	N
Have you completed a hazard assessment (HA) on your process that includes the precursors and any emissions from the process including the nanoparticles themselves?	Y	
Have the engineering devices been inspected for proper function?	Y	
Are you fully aware of the properties of the precursors used for nanomaterial synthesis? And have you alerted all other potentially exposed people to those properties? (This includes everyone being aware of both what is known and what is NOT known about these chemicals and nanoparticles.)	Y	
Have you prepared your emergency response procedure and cleared it with EH&S or potential responders?	Y	
Is the chemical fume hood free of clutter (solvent bottles, samples, combustible materials)?	Y	

https://www.cdc.gov/niosh/docs/2009-125/pdfs/2009-125.pdf

Risk Assessment *vs.* Hazard Assessment

Identify the hazards ⇒ **What if scenarios Checklist SOPs**

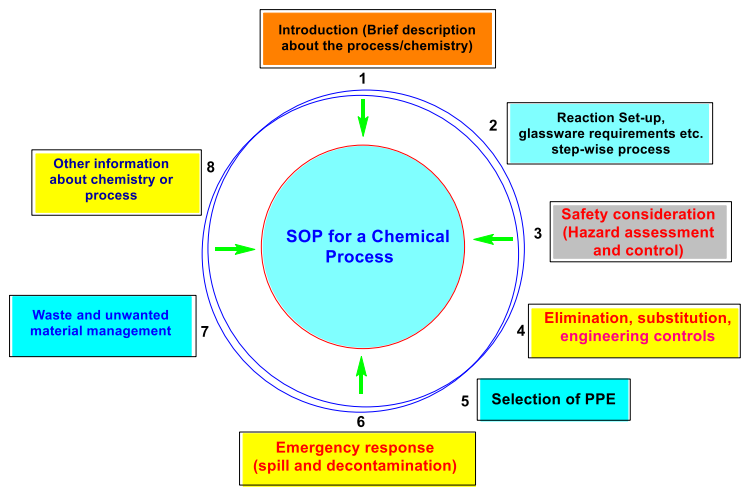
Consider the reactivity and flammability of the precursors, possibility of formation of side products



What if?	Answer	Result	Consequences	Recommendations
Glassware is not Moisture-free	Possibility of a runaway rxn due to moisture	A fire or an explosion	Likelihood of loss of material, and property loss, and chemical exposures	Glassware should be flame-dried under vacuum or assembled after being dried in the oven and allowed to cool to room temperature under vacuum.
Pyrophoric nanomaterial container opened in the air without N2	Introduction of Into container	A fire and explosion can occur	Product and undesired events	All small-nanomaterials should be handled under an inert atmosphere.

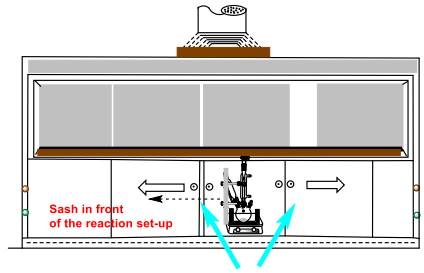
Stuart, R. *J. Chem. Health Saf.* **2019**, 26, 4-5, 2 - 5.
Langerman, N. *J. Chem. Health Saf.* **2009**, 16, 4, 22 - 28.

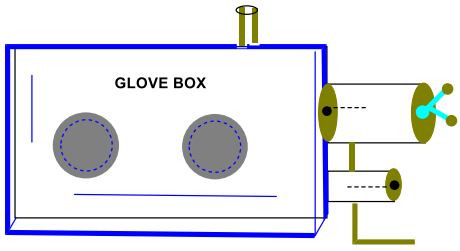
SOP Components for a Chemical Process

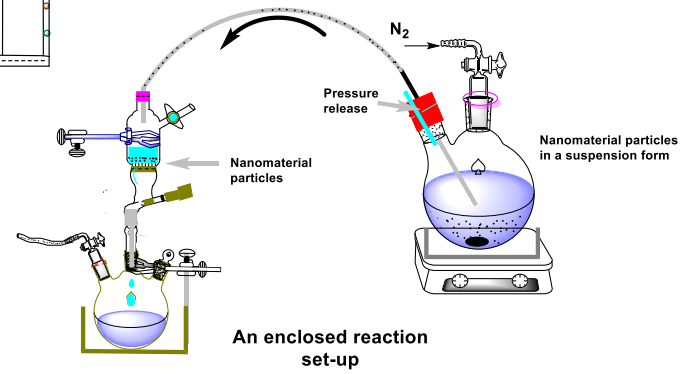


Chandra, T.; Zebrowski, J. P.; McClain, R.; Lenertz, L.Y. Generating Standard Operating Procedures for the Manipulation of Hazardous Chemicals in Academic Laboratories. *ACS Chem. Health Saf.* 2021, 28, 1, 19-24.

Nanomaterials: Engineering Controls & Techniques







Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT

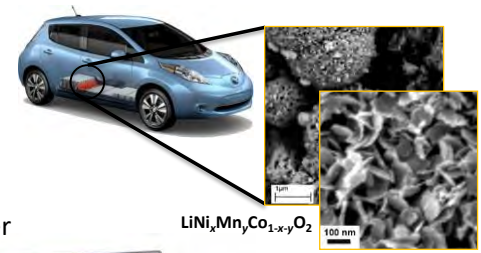
Which of these information resources do you use for nanomaterials hazard assessments and management practices? (Select all that apply)

- Government resources (NIOSH and CDC references)
- ACS Journals (Organic Process Research and Development or ACS Chemical Health and Safety)
- Bretherick's Handbook of Reactive Chemical Hazards
- Peer discussions with colleagues or electronic peer resources (DCHAS Listserv)
- Other (Let us know more in the chat!)

** If your answer differs greatly from the choices above tell us in the chat!*

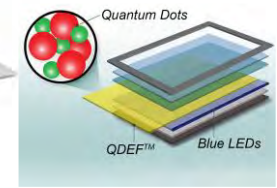
What do we know about nanotoxicity?

- Much of the early nanoEHS research has focused on simple systems that may or may not be relevant to human exposure
- Some nanoparticles can translocate throughout the body after exposure via inhalation, contact with skin or ingestion
- Some nanoparticles can induce unwanted health effects in animals or cell cultures
- With the increase in nanomaterial-related research, there are many materials that have limited or no safety data available



$LiNi_xMn_yCo_{1-x-y}O_2$

CdSe Quantum Dots



Smith et al, *J. Am. Chem. Soc.* **2013**, 135, 11580−11586

Common techniques to avoid airborne exposure in our lab

1 2 3 4

5

1) Glove boxes
2) Keeping particles wet or fully suspended
3) Nano hood
4) N95 dust masks
5) Small scales in fume hoods

Proper nanomaterial disposal is another key to safety

- Disposal procedures vary institution to institution

- At UW-Madison and in the Hamers group nanoparticles are disposed in a way to avoid airborne particle exposure

Waste Disposal: *Describe any chemical waste generated and the disposal method used.*

Solids should remain sealed and not left for possible atmospheric dispersal or inhalation. Solid spills on floor or bench should be cleaned with a wet towel while wearing gloves. Waste nanoparticles should be triple sealed in plastic bags or dispersed in liquid in glass containers for disposal by chemical safety. Nanoparticle films on substrates should be disposed in mixed chemical waste and not in glassware or trash.

Accidental Spills: *Describe procedure for handling small chemical spills that may occur during this procedure. Note that for large spills it may be appropriate to call 911.*

Rinse with water or other liquid. Ensure that spilled nanoparticles do not dry out or otherwise become a potential inhalation hazard. Keep wet whenever possible. Clean with wet paper towels and dispose of towels by sealing in plastic bag and dispose of as mixed chemical waste. Do not allow any amount of spilled nanoparticles to be placed in trash or other location where they may become an airborne inhalation hazard.

The NSF Center for Sustainable Nanotechnology

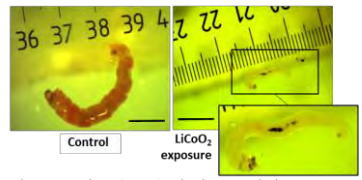
Perspectives on nano in the environment

The NSF Center for Sustainable Nanotechnology

Nanomaterials can cause damage at sub-lethal doses

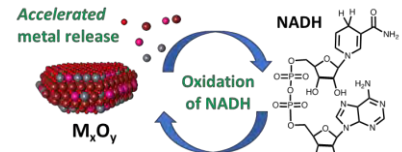
Phenomenological observations

Chironomid size and color change



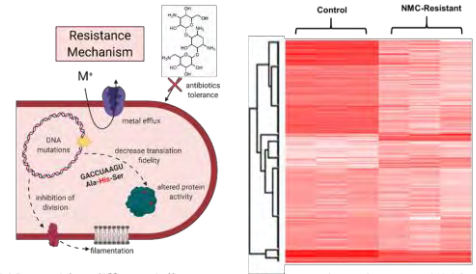
Niemuth, N. J. ,*et. al.*; *Environ Sci Technol* **2020,** *54* (23), 15257-15266.

Metal redox interfering with biomolecules



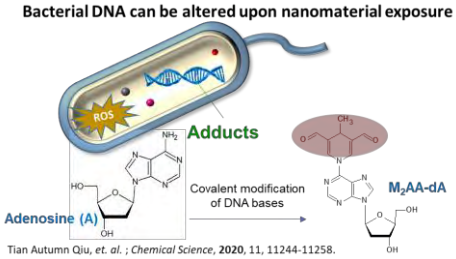
Henke, A., et. al. **2021** (submitted)

Bacteria can become resistant after nanoparticle exposure



112 peptides differentially expressed in bacteria resistant to NMC nanoparticles. Mitchell, S. L., *et. al.*; *Chemical Science*, **2019**, 10, 9768-9781.

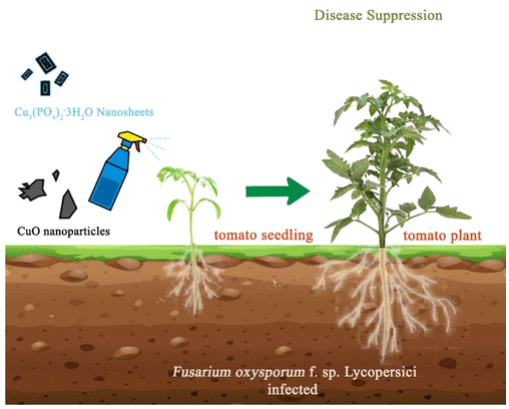
Bacterial DNA can be altered upon nanomaterial exposure

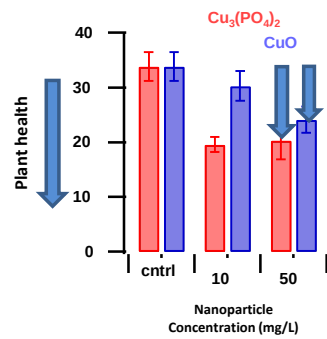


Tian Autumn Qiu, *et. al.* ; *Chemical Science*, **2020**, 11, 11244-11258.

There are positives to nanomaterials in the environment as well.

Nanomaterial treatments can reduce effects of plant disease





Future work:

- Nutrient delivery (Cu, N, etc.)
- Disease prevention

The NSF Center for Sustainable Nanotechnology

Jaya Borgatta, et. al.; *ACS Sustainable Chemistry & Engineering*, **2018**, 6 (11), 14847-14856.
Yu Shen et. al.; *Journal of Agricultural and Food Chemistry*, **2020**, 68 (41), 11327-11338.

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT

What is your BIGGEST SAFETY CONCERN while handling the nanomaterials in your lab or the department?

- Sufficient safety information is not available on the nanomaterials themselves
- Concern about potential health effects of incidental exposure to them
- Not sure of how to select the best engineering controls
- Not enough literature is available on the material and its precursors to perform a complete process risk assessment
- Other (Let us know in the chat!)

** If your answer differs greatly from the choices above tell us in the chat!*

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- Guide participants towards gaining awareness of safety culture messages from leadership at their institutions
- Empower participants to expand their safety networks and develop laboratory safety teams

https://dchas.org

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- Why criminal investigations and prosecutions under the DOJ's "China Initiative" are unjust to Chinese scientists and damaging to American leadership in science and technology
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Moderator: Deeksha Gupta, American Chemical Society

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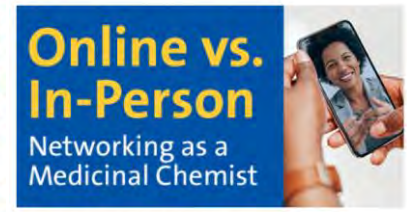

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