

Construction Workers and Nanomaterials: Perspective of Vulnerable and Unique Stakeholders

**Session D: Emerging Technologies and
Advanced Materials**

QUEEN II, October 9, 2018

Bruce Lippy, Ph.D., CIH, CSP

Director of Safety Research, CPWR

Gavin West, MPH

Analyst, CPWR



Early Nanotechnologists



Lycurgus Cup

http://www.britishmuseum.org/explore/highlights/highlight_objects/pe_mla/t/the_lycurgus_cup.aspx

CPWR is a U.S. nonprofit that conducts research into construction health and safety (www.cpwr.com)



[about](#) [contact](#) [publications](#)

research
training
service

CPWR is dedicated to reducing occupational injuries, illnesses and fatalities in the construction industry. Through our research, training, and



A world leader in construction safety and health research and training

CPWR's Informational Webinar Series



CPWR hosts regular webinars on a variety of topics including current research, new efforts and trends in occupational safety & health, and training programs. The following is a list of upcoming webinar events. To register, click on the event link and select register (as opposed to join now). Space is limited for all events, so we encourage you to register in advance. Further instructions will be provided when

My comments are my own and not those of NIOSH, the source of our nanotechnology research funding

Emerging technologies and advanced materials bring to mind:

Center for
Nanophase
Materials
Science, Oak
Ridge, TN



But not construction!

Here are the questions I'd like to tackle:

1. Why are construction workers particularly vulnerable stakeholders?
2. What can we say about construction workers' exposure to engineered nanomaterials?
3. What are we doing to understand the hazard posed by construction nanomaterials?
4. How are we doing communicating risk to construction workers?

Why are construction workers particularly vulnerable stakeholders?

Question 1

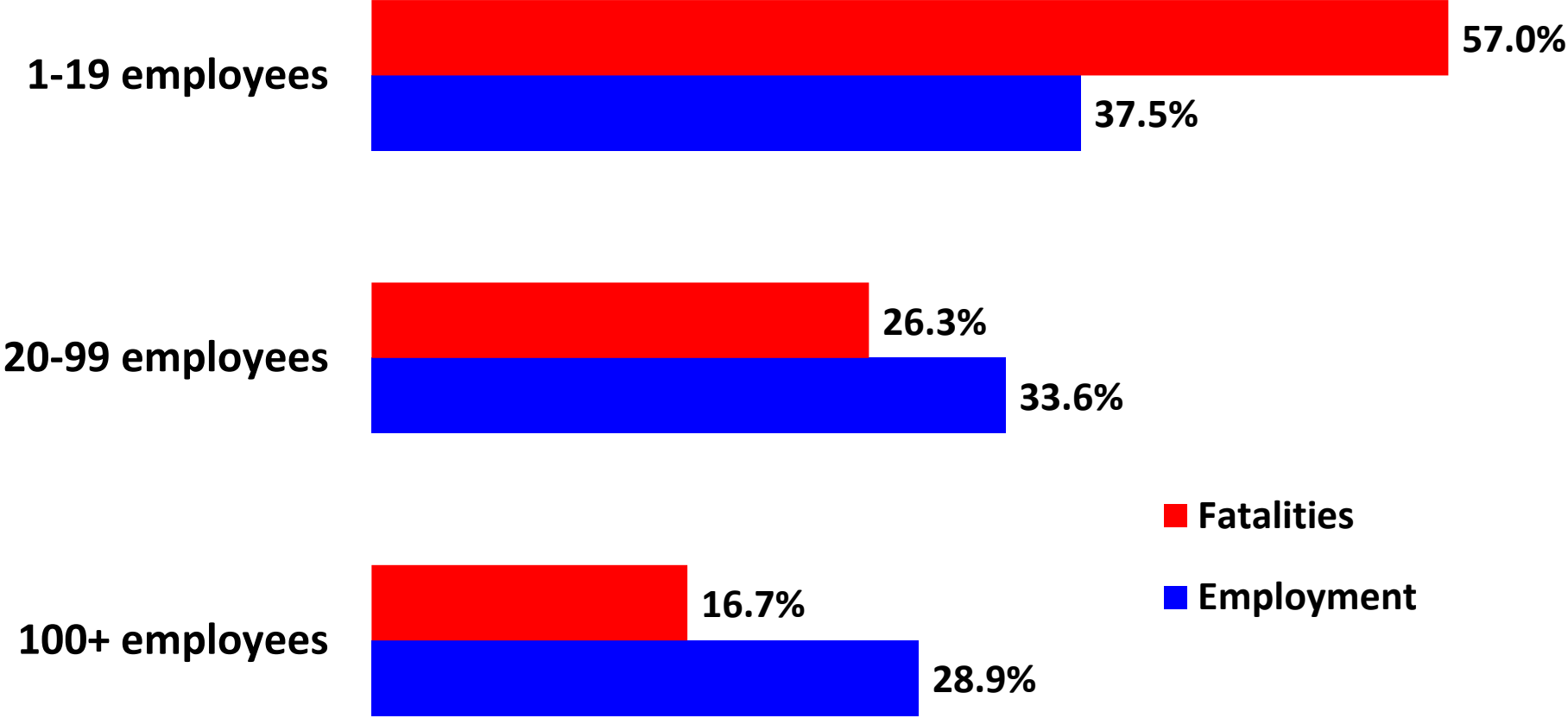


Construction is dominated by small employers and a diverse workforce

- **90% have <20 employees**
- **About 80% have <10 employees**
- **30% of workers are Hispanic**
- **14% are employed by temp agencies**



Small firms represent a disproportionate percentage of construction fatalities (2015)

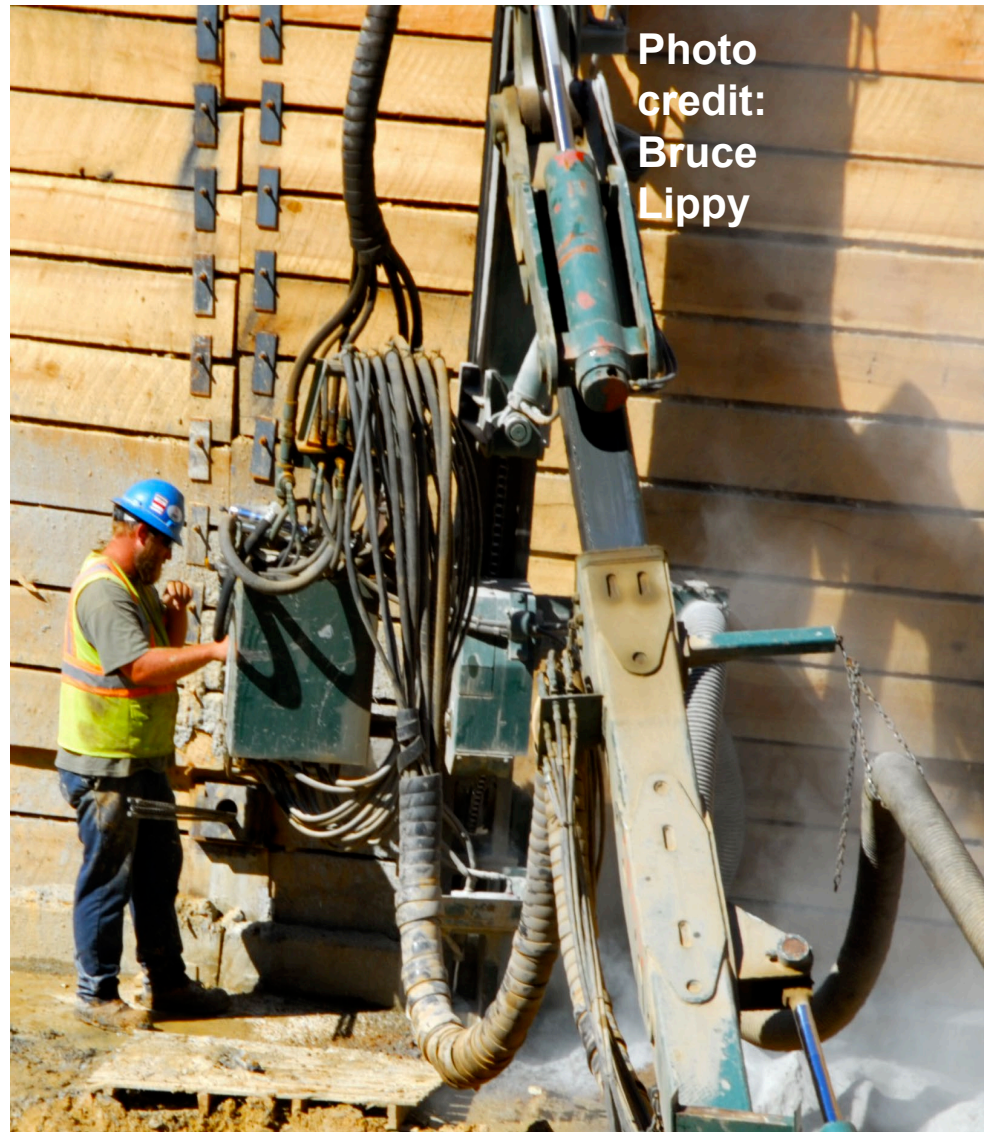


An aerial photograph of a large-scale construction project, likely a power plant or industrial facility. The site is filled with various structures, including large circular tanks and rectangular buildings under construction. Numerous cranes of different colors (blue, red, yellow) are positioned across the site, some with their jibs extending high into the air. The ground is a mix of dirt, gravel, and concrete. In the background, there are more completed buildings and some greenery. The overall scene depicts a busy and complex construction environment.

**Materials represent the
largest expense category for
construction**

**U.S. Census Bureau. 2007
Economic Census,
Construction Subject Series**

In 2010, more than half of U.S. construction workers reported exposure to vapors, gas, dust or fumes twice a week or more



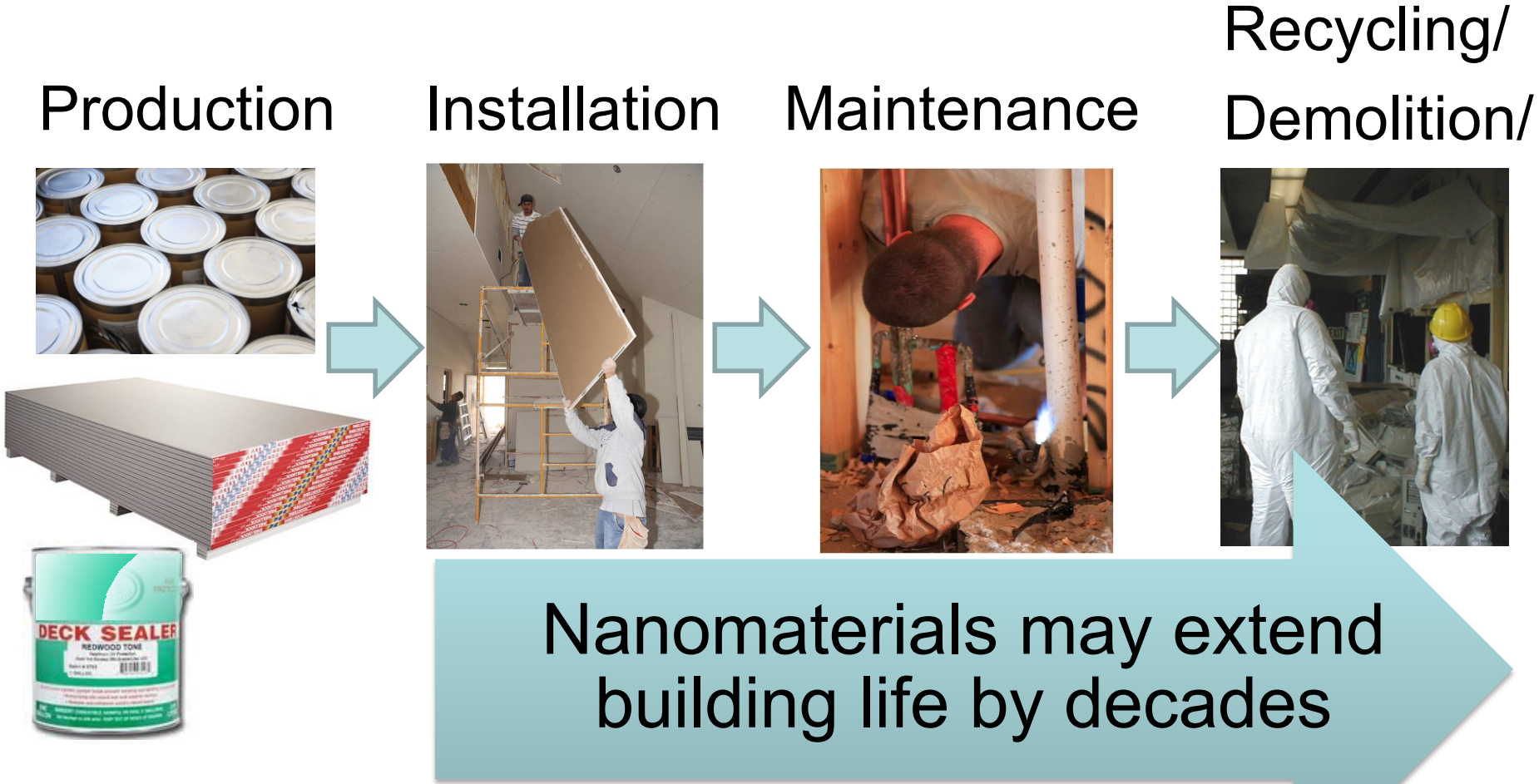
Liss GM, Petsonk EL, Linch KD [2010, Nov]. The construction industry. In: Occupational and Environmental Lung Diseases

Bystander exposures can be significant in construction



Photo courtesy of the NJ Department of Health and Senior Services' NIOSH-funded Silicosis Surveillance Project

Providing useful information will be difficult over the life cycle of construction



ENMs are being used in high volume materials

In 2015, concrete road surface enriched with carbon nanotubes was tested on a road in GA and approved by GA DOT



Photo courtesy Wikimedia Commons

Toxicology studies have focused on raw ENMs



Photos courtesy
Wikimedia Commons



Not on mixed
construction dust

**What can we say about
construction workers' exposure to
engineered nanomaterials?**

Question 2



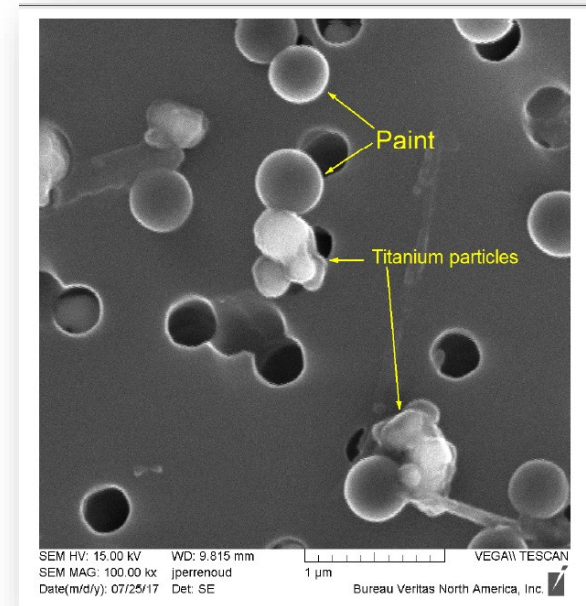
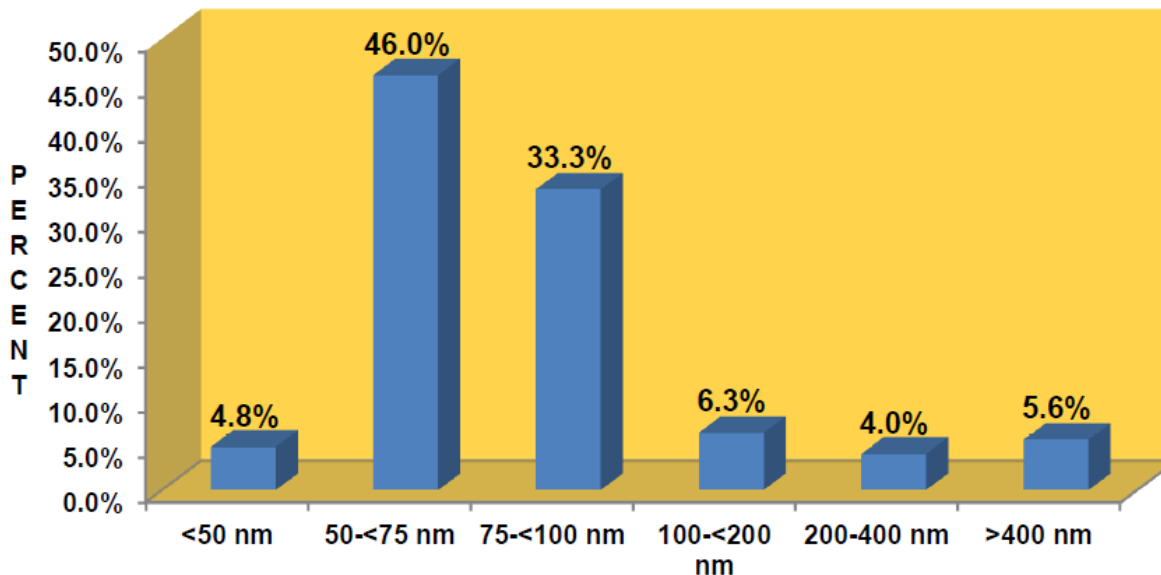
Multiple studies have evaluated release of NOAA from coatings during sanding

(Dylla and Hassan, 2012; Vaquero, Gelarza and Ipina, 2015; West et al. 2016)

Results are mostly encouraging with regard to worker health.

April 2017, we sampled exposures during spraying paint containing nano titanium dioxide, with subsequent sanding

SAMPLE 217099 BEHR PAINT TITANIUM PARTICLE SIZE



We used the same 3-pronged sampling approach



Photo
courtesy
Earl Dotter

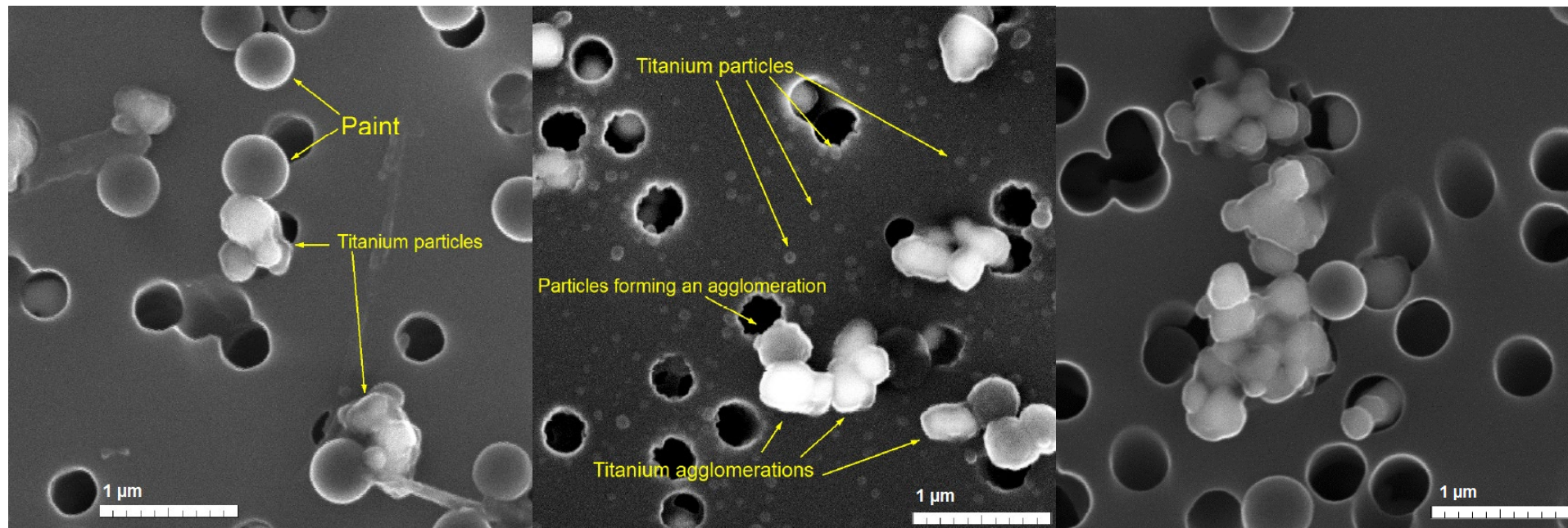
Prong 1: Real-time instruments
**TSI Scanning Mobility Particle Sizer
and Optical Particle Sizer**

Prong 2: standard industrial hygiene sampling for dust and metals



Photos
courtesy
Earl Dotter

Prong 3: electron microscopy of bulk and airborne particles



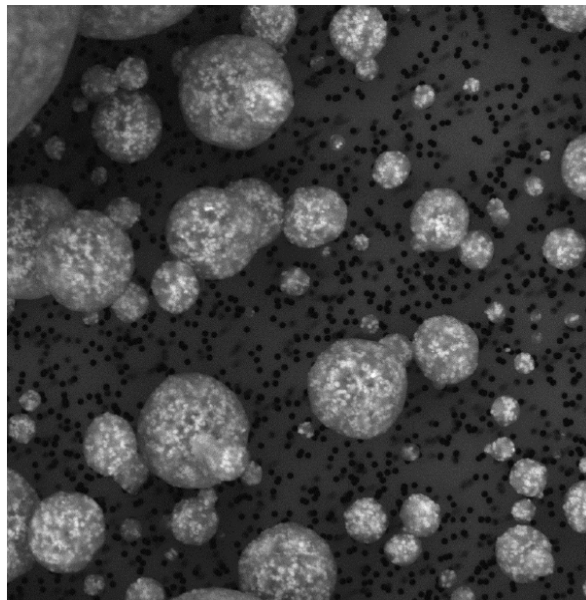
Sonicated in water

Sonicated in acetone

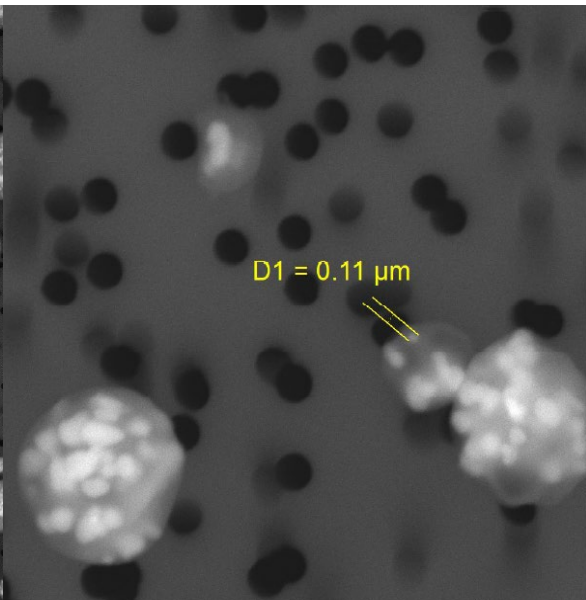
Conventional paint in acetone

SEM bulk characterization of paint

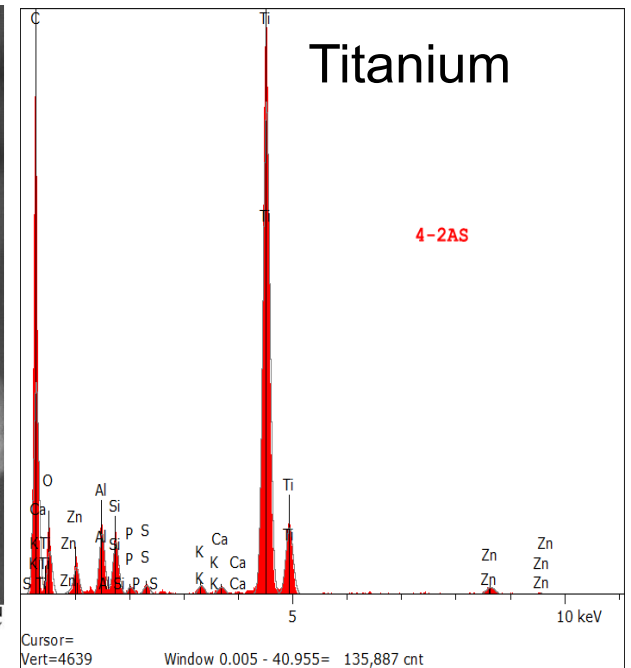
SEM images and EDS spectra of airborne particles from **spraying**



SEM HV: 15.00 kV WD: 9.818 mm
SEM MAG: 10.00 kx jperrenoud
Date(m/d/y): 09/15/17 Det: BSE



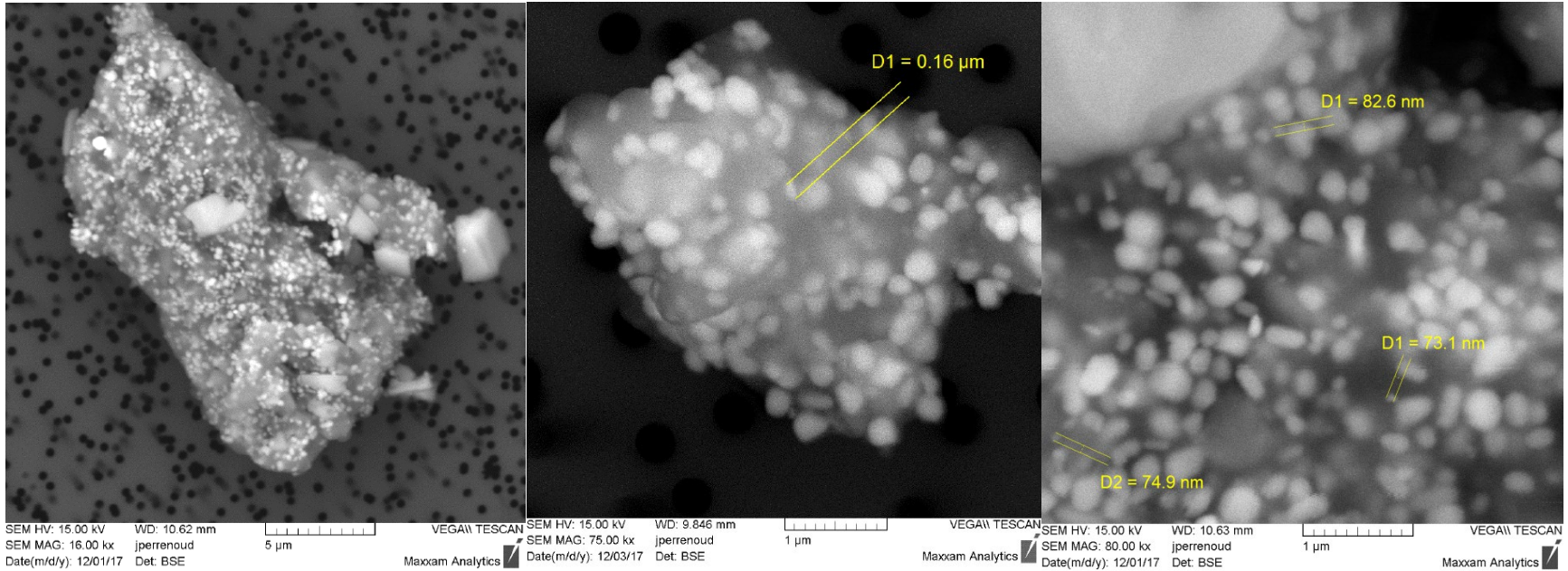
SEM HV: 15.00 kV WD: 9.905 mm
SEM MAG: 60.05 kx jperrenoud
Date(m/d/y): 09/18/17 Det: BSE



10,000 x

20,000 x

SEM images of airborne particles from sanding

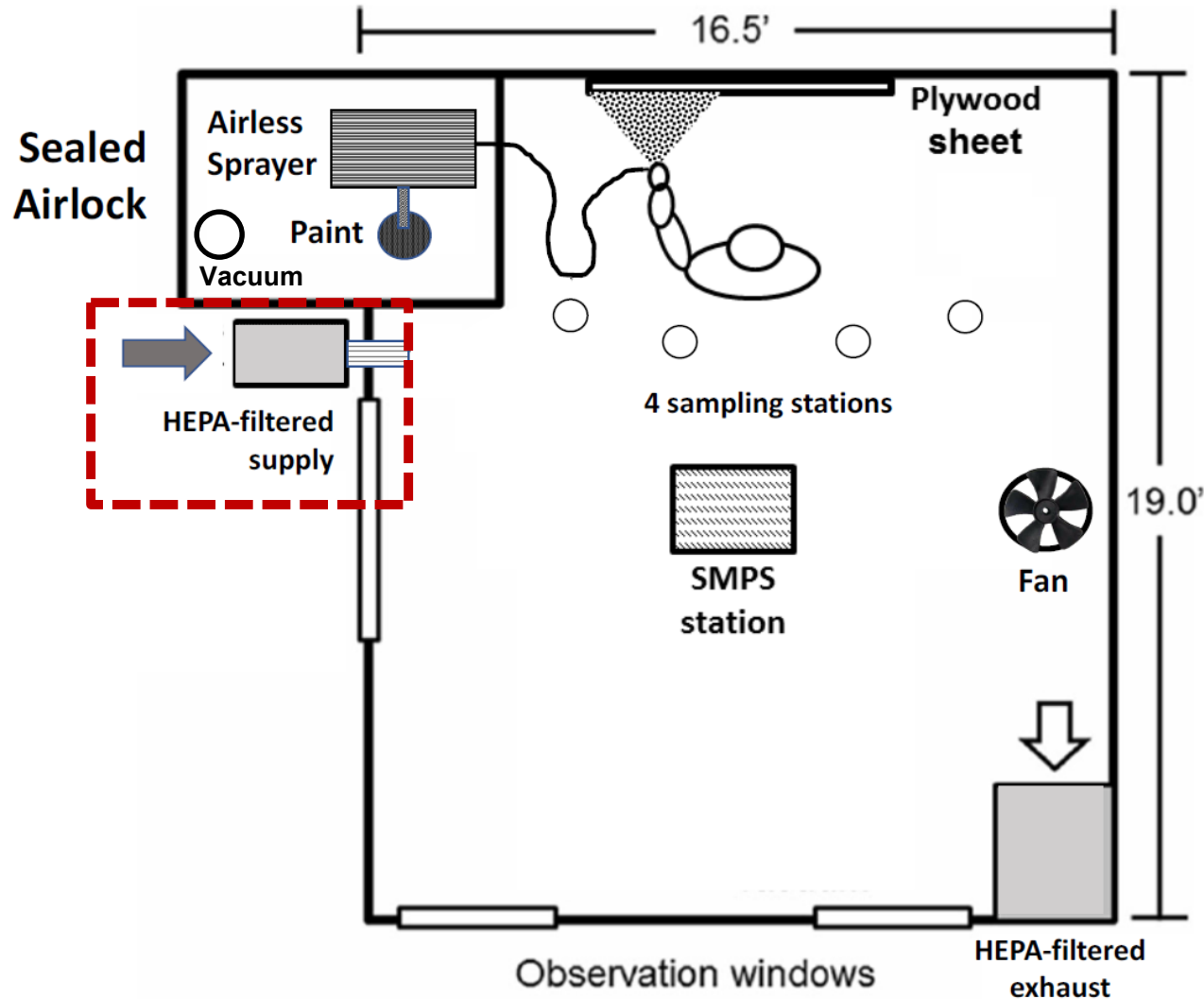


16,000 x

75,000 x

80,000 x

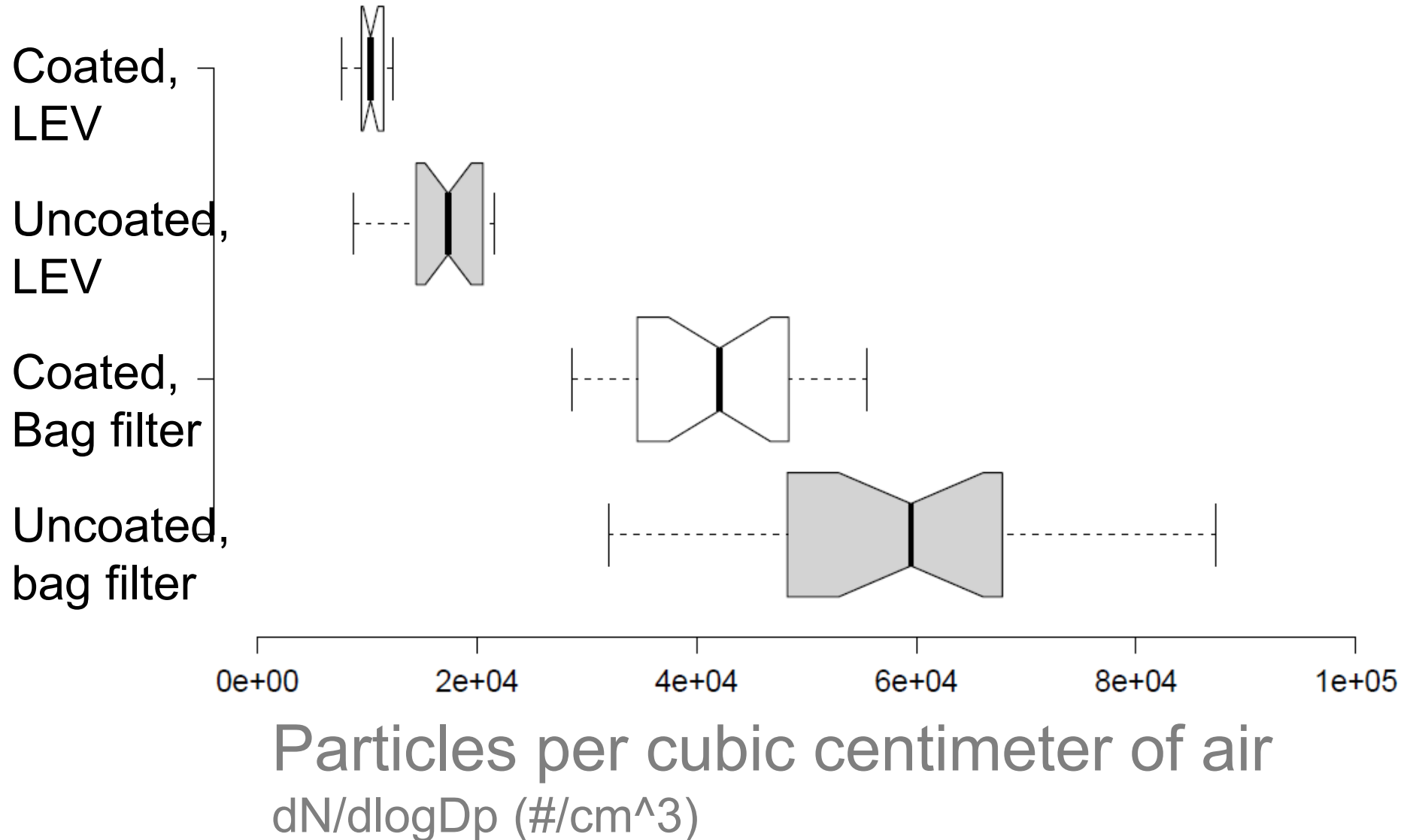
We used an environmental chamber with HEPA-filtered air



We sprayed and then sanded plywood sheets



We again demonstrated LEV can significantly reduce nanoparticle release



“This study may be the first to provide evidence suggesting potential for overexposure to nano-TiO₂ during routine construction activity in reference to the NIOSH REL for ultrafine TiO₂ (0.3 mg/m³ as a 10-hour TWA)”

West et al., draft manuscript

Personal air sampling data

Exposure Agent	N	Mean Conc. (mg/m ³)	Std. Dev.	95%CI
Total Particulate	5	35.8	8.6	25.1 - 46.5
TiO ₂	5	13.6	3.2	9.6 - 17.6
Respirable Particulate	5	2.1	0.7	1.2 - 3.0
Respirable TiO₂	5	0.7	0.1	0.5 - 0.9

What are we doing to understand the hazard posed by construction nanomaterials?

Question 3

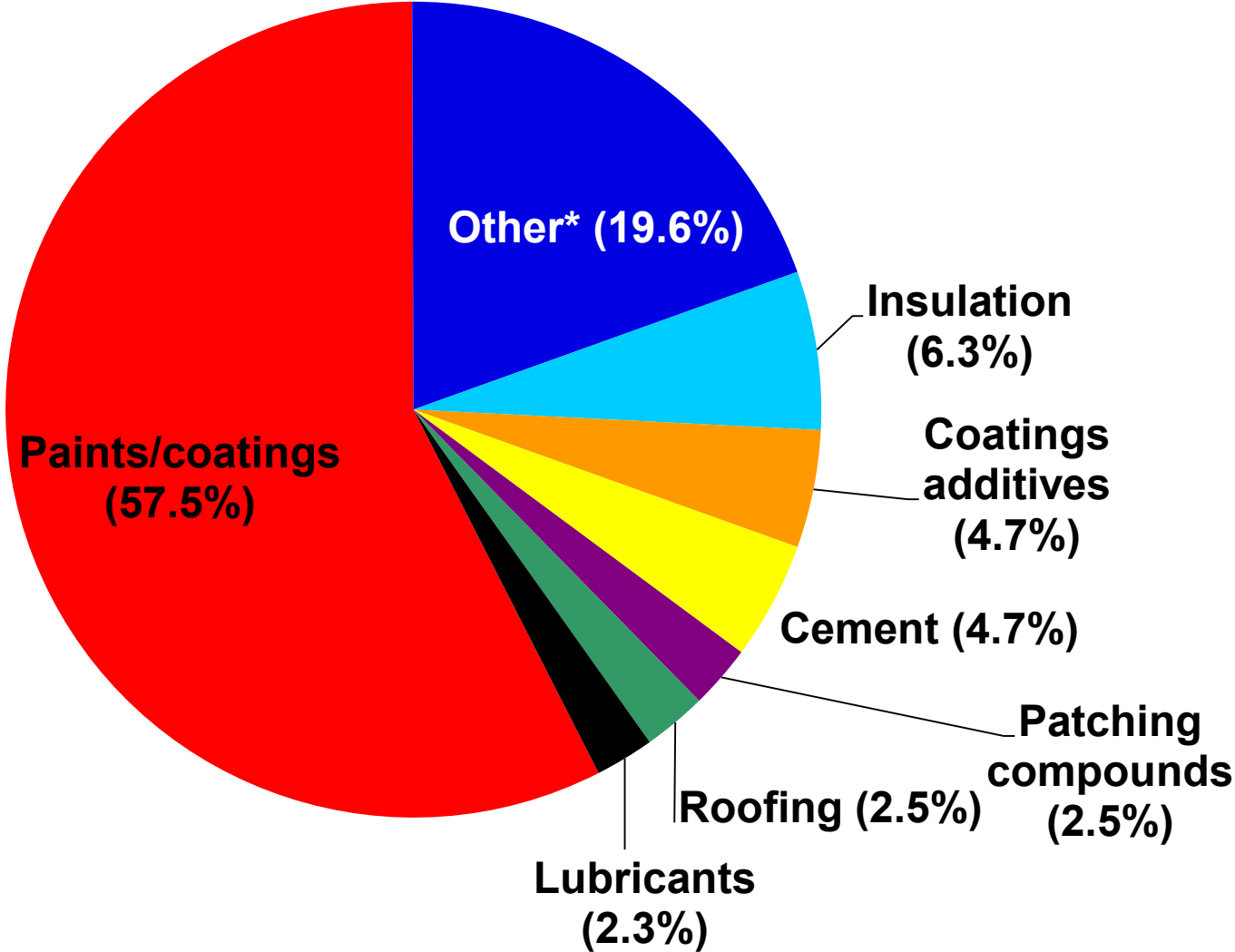


Our site currently features 583
commercial **construction products**
reported to be nano-enabled and
265 articles



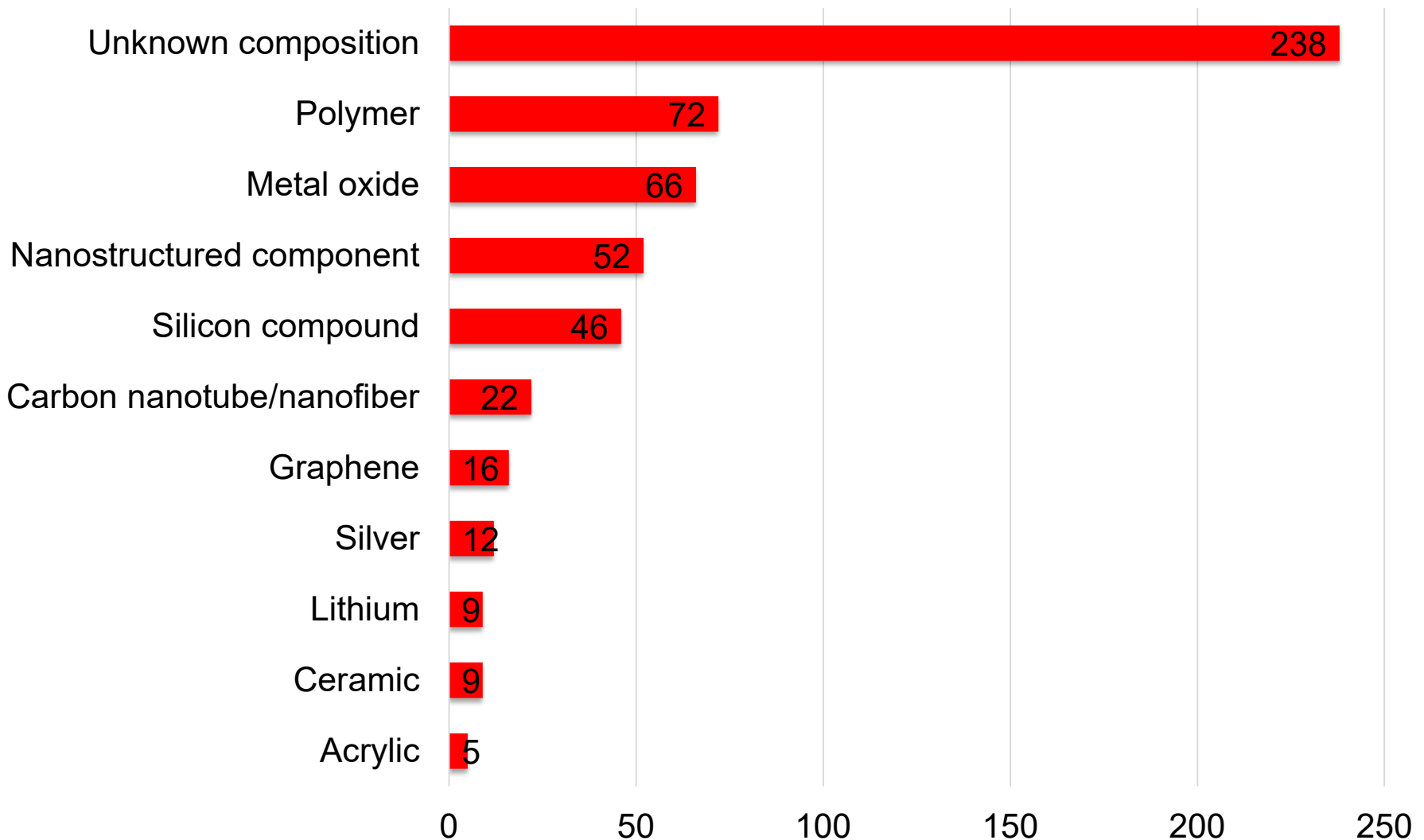
www.nano.elcosh.org

Paints and coatings still dominate



Draft Chart Book graphic (2a)

“Unknown composition” represent the largest group (number of nanomaterials)



NIOSH collected aerosol samples for toxicity testing (June 2015)





In 2017, Dr. Jenny Roberts from NIOSH again collected dust for in vitro and in vivo tox testing

**How are we doing
communicating risk to
construction workers?**

Question 4



Safe Work Australia found SDSs lacking (2010)

- Evaluated 50 SDSs
- **18%** (9/50) “were assessed as providing reliable information to appropriately inform an occupational risk assessment”



[Safe Work Australia \(SWA\). 2010. *An Evaluation of MSDS and Labels associated with the use of Engineered Nanomaterials*. Commonwealth of Australia.](#)

Lee et al. (2012) found critical information missing

- Evaluated 97 SDS
- Info missing on routes of entry, toxicology, and protective measures
- Widespread use of OELs for the bulk forms

Lee et al. (2012) Nanotoxicology

**ISO has published a 2012
technical report for writing
nano SDSs that is quite good!**

ISO/TR 13329

***Nanomaterials: Preparation of
Material Safety Data Sheet
(MSDS)***



CPWR surveyed 79 worker-trainers from 22 trades with an average of **30 years in the trade**

(2013-2014)

Survey Respondent Characteristics	N	Mean	SD	Range
Years in trade	78	30.5	9.4	9-55
Years as a trainer	79	13.3	7.8	1-34

Nearly half were not aware that nano had been applied to construction materials

	Yes	No
Aware that nanotechnology has been applied to construction materials?	41 (52%)	38 (48%)
Aware that construction products containing nanomaterials are commercially available in the USA?	38 (48%)	41 (52%)

CPWR funded a Small Study focused on nanotechnology awareness

Laura Boatman and Debra Chapman, State Building and Construction Trades Council of CA

Explore awareness among CA construction unions and employers about nano

- Used questions from CPWR nano survey
- Received 253 written surveys from Survey Monkey
- Followed up with 21 key informant interviews



**“Comprehensive
nanotechnology training is
virtually non-existent.”**

Boatman and Chapman, 2018

We are creating nano toolbox talks for the trades

MOSH CPWR®
ToolBox Talk

Nano-Enabled Wood Coatings and Stains




- ✘ Use a hose on your orbital sander, running to a vacuum with a HEPA filter to capture the dust before it gets into the air.
- ✘ Use a respirator if the vacuum does not capture all of the dust or when a vacuum system is not available.
- ✘ Wear goggles or a face shield to protect your eyes from the dust and hearing protection to prevent hearing loss.

May 2015. The National Institute for Occupational Safety and Health (NIOSH), of the Centers for Disease Control and Prevention (CDC), produced this content in partnership with CPWR, The Center for Construction Research and Training. This document is in the public domain and may be freely copied or reprinted. Mention of any company or product does not constitute endorsement by NIOSH.

CDC **MOSH CPWR®**
RESEARCH AND TRAINING

MOSH CPWR®
ToolBox Talk

Nano-Enabled Cement Materials with Titanium Dioxide



- ✘ Use a power saw with water or attached to a vacuum with a HEPA filter to capture the dust before it gets into the air.
- ✘ Use a respirator if the water or vacuum alone do not capture enough of the dust.
- ✘ Wear goggles or a face shield to protect your eyes from the dust, and hearing protection to prevent hearing loss.

May 2015. The National Institute for Occupational Safety and Health (NIOSH), of the Centers for Disease Control and Prevention (CDC), produced this content in partnership with CPWR, The Center for Construction Research and Training. This document is in the public domain and may be freely copied or reprinted. Mention of any company or product does not constitute endorsement by NIOSH.

CDC **MOSH CPWR®**
RESEARCH AND TRAINING

The AIHA Nanotechnology Working Group is a valuable resource



[Sign In](#) | [About](#) | [Contact](#) | [Find Consultant](#) | [CareerAdvantage](#) | [MEMBER CENTER](#)

[DISCOVER IH](#)

[MEMBERSHIP](#)

[EDUCATION](#)

[EVENTS](#)

[PUBLICATIONS & RESOURCES](#)

[GOVERNMENT AFFAIRS](#)

[GET INVOLVED](#)

Volunteer Groups

- [Volunteer Group Communities](#)
- [Sample Future Community Worksites](#)

Local Sections

Students and Young Professionals

Special Interest Groups

[Home](#) > [Get Involved](#) > [Volunteer Groups](#) > [Nanotechnology Working Group](#)

Nanotechnology Working Group

Mission

Provide AIHA members and technical committee representatives with opportunities to identify, organize, and conduct information sharing, educational activities, and community outreach in the cross-cutting area of nanotechnology safety and health.

Ongoing and Upcoming Activities and Events:

Thanks! Questions?

Bruce Lippy, Ph.D., CIH, CSP

Director of Safety Research

blippy@cpwr.com

301-495-8527

410-916-0359 cell

<http://www.elcosh.org>

