

# PROGRESS AND PLANS OF NATIONAL NANOTECHNOLOGY INITIATIVE (NNI) AGENCIES

December 2019

## Department of Health and Human Services (DHS)<sup>1</sup>

### *National Institute for Occupational Safety and Health (NIOSH)*

#### Summary

NIOSH provides national and world leadership in conducting research on the causes and prevention of work-related illness and injury. NIOSH is a leader in the Federal Government research initiative on understanding the potential human health and safety implications of nanotechnology, and in addressing worker health and safety needs related to nanotechnology. NIOSH research advances the understanding of engineered nanomaterial-related toxicology and workplace exposures, so that appropriate risk management practices can be implemented during the discovery, development, and commercialization of engineered nanomaterials along their product life cycles. Through strategic planning, research, collaborating with stakeholders, and making information widely available, NIOSH develops guidance that supports and promotes the safe and responsible development and commercialization of nanomaterials.

#### Plans and Priorities by Program Component Area (PCA)

##### PCA 5. Environment, Health, and Safety

NIOSH will continue to conduct toxicology studies to evaluate biomarkers of exposure and disease using proteomic, metabolomic, and bioinformatic approaches; to develop innovative *in vitro* methodology to better predict *in vivo* outcomes; and to evaluate pulmonary and dermal exposure and toxicity, and systemic toxicity that results from occupational exposures, including effects in the cardiovascular, reproductive, neurological, and immune systems in response to wide variety of nanomaterials and nanotechnology-enabled products along the life cycle of the materials.

NIOSH plans to develop, test, and evaluate direct-reading instruments capable of detecting and measuring airborne nanoparticles. Additional plans include continuing field tests of the portable aerosol multielement spectrometer developed by NIOSH at nanomaterial producer and user facilities, as well as efforts in detection of airborne nanoparticles, including in biological systems, to evaluate and predict biological behavior and translocation between organ systems. NIOSH will also explore the feasibility of applying

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advanced sensing technology to biomarkers as a means of evaluating nanomaterial exposure and possible early response.

NIOSH will continue to develop occupational safety and health guidance that can be incorporated into business plans to both protect worker safety and promote application development and commercialization.

NIOSH is releasing a Federal Register Notice<sup>2</sup> requesting nanotoxicology data for evaluation in developing a draft technical report, Approaches to Developing Occupational Exposure Limits or Bands for Engineered Nanomaterials.

NIOSH and the Consumer Product Safety Commission will continue collaborations to study the release of engineered nanomaterials from 3D printers. NIOSH will also work with universities and industry to promote safe practices in nanotechnology and advanced manufacturing. NIOSH plans to work with industry to develop practical, “real world” evaluation of hazard and risk represented by nanomaterials through their life cycles, focus the NIOSH field research effort on outputs that support the Sustainable Nanomanufacturing NSI, and collaborate with industry to assess the toxicology of carbon and metal-based nanomaterials, nanocellulose, and nanoclay-enabled materials.

NIOSH plans to continue collaborations with CPWR,<sup>3</sup> trade unions, and industrial partners to evaluate nanotechnology-enabled spray coatings, composites, and other nanomaterials used in construction and manufacturing.

NIOSH plans to continue collaborations with ISO 23151 - Nanotechnologies - Particle Size Distributions for Cellulose Nanocrystals,<sup>4</sup> and the OECD Test Guideline 110 - Particle Size Distribution/Fibre Length and Diameter Distributions.<sup>5</sup>

## Key Technical Accomplishments by NNI Goal

### Goal 4. Support Responsible Development of Nanotechnology

#### *Understanding and mitigating potential impacts in the workplace*

As nanomaterials and nanotechnology-enabled products make their way into commerce, NIOSH works to fully understand the potential health and safety impacts of nanotechnology in occupational settings. NIOSH researchers develop hazard and safety assessments using key classes of engineered nanomaterials, including different forms of carbon nanotubes; metals and metal oxides; high-aspect-ratio materials including boron nitride nanotubes, carbon nanofibers, silver and titanium nanowires, and nanocellulose crystals and nanofibers; and 2D nanomaterials including graphene, graphene oxide, hexagonal boron nitride, and nanoclays. “Real-world” evaluations of hazard and risk represented by various nanomaterials through their life cycles have been performed by NIOSH, including the characterization of aerosols generated in spray coating of paints, sealants, and disinfectants. Environmental chambers are being used to evaluate sanding, sawing, and cutting of nanotechnology-enabled polymer composites and construction materials, as well as sanding of coated surfaces, in a controlled environment. NIOSH also has collaborated with over 20 national and international universities and numerous industrial partners in the characterization

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<sup>2</sup> <https://www.federalregister.gov/documents/2019/12/17/2019-27169/request-for-information-on-toxicological-and-physicochemical-data-of-engineered-nanomaterials-to>

<sup>3</sup> <https://www.cpwr.com/>

<sup>4</sup> <https://www.iso.org/standard/74742.html>

<sup>5</sup> <https://doi.org/10.1787/9789264069688-en>

of toxicological effects of pulmonary and dermal exposure to a wide range of industrially relevant nanoparticles and nanotechnology-enabled materials.

Agencies participating in the NNI are actively engaging with industry to share nanotechnology-related environmental, health, and safety knowledge and best practices. NIOSH field research teams visit nanomaterials producers and users and conduct industrial hygiene evaluations. NIOSH has used its research findings to develop guidance documents and other communication tools to protect workers from occupational injury and illness. NIOSH participated in numerous webinars and in-person seminars reaching hundreds of workers and employers, providing them with information on how to work safely with nanomaterials and other advanced materials.

NIOSH is responding to external peer and public review comments on the second draft of the *Current Intelligence Bulletin on Occupational Exposure to Silver Nanomaterials*,<sup>6</sup> and anticipates publication of this document in 2020.

NIOSH created two additional workplace posters “3D Printing with Filaments: Health and Safety Questions to Ask”<sup>7</sup> and “3D Printing with Metal Powders: Health and Safety Questions to Ask,”<sup>8</sup> to provide options to companies for controlling possible exposure of their workers to printer emissions and possibly nanomaterials and other advanced materials.

*NIOSH collaborations with industry to conduct voluntary on-site assessments of workplace exposures*

NIOSH has established collaborations that evaluate workplace processes, and develops methods to identify and quantify worker nanomaterial exposure. Collaborating organizations gain access to NIOSH’s expertise in nanomaterial characterization and exposure control technology. NIOSH field research teams visit nanomaterials producers and users, including additive manufacturing and 3D printing facilities. During 2019, NIOSH collaborated with 12 companies and completed 20 field assessments. Revisits to companies demonstrated that the NIOSH guidance was followed and reduced exposure potentials.

NIOSH evaluated the work environment during destructive testing of carbon nanotube (CNT)-enabled concrete further during 2018–2019, and results demonstrated no release of free or unbound CNTs during grinding and compression tests. Field assessment work with one company provided the opportunity for it to participate in toxicologic evaluations of its nanomaterial. NIOSH is working with a printer manufacturer interested in developing its own local exhaust ventilation (LEV) to build into its newest model of a fused filament fabrication (FFF) printer. NIOSH is also doing a focused study in non-traditional workplaces such as schools that are using 3D printers. NIOSH initiated an exposure study on two-dimensional nanomaterials, such as graphene, and completed four site assessments at companies producing and using graphene.

NIOSH is continuing to develop an exposure registry that currently consists of ~585 workers across the United States that have been exposed to carbon nanotubes and nanofibers in the workplace. This registry will form the base of a longitudinal study that will evaluate the early health effects of exposure to carbon nanotubes or nanofibers among workers exposed to these engineered nanomaterials.

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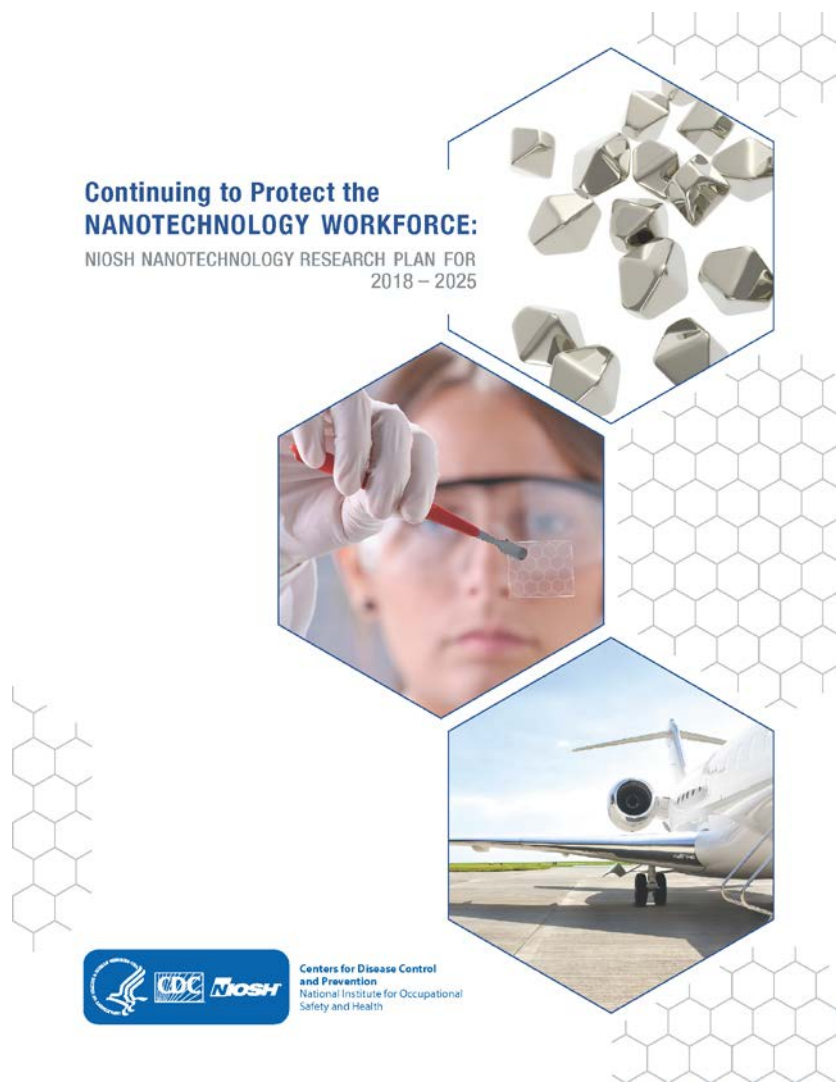
<sup>6</sup> [https://www.cdc.gov/niosh/docket/review/docket260a/pdfs/260-A-Draft-Silver-NM-CIB\\_8-24-18\\_1.pdf](https://www.cdc.gov/niosh/docket/review/docket260a/pdfs/260-A-Draft-Silver-NM-CIB_8-24-18_1.pdf)

<sup>7</sup> <https://www.cdc.gov/niosh/docs/2020-115/default.html>

<sup>8</sup> <https://www.cdc.gov/niosh/docs/2020-114/default.html>

*Updated NIOSH Nanotechnology Research Plan*

In January 2019, NIOSH published *Continuing to Protect the Nanotechnology Workforce: NIOSH Nanotechnology Research Plan for 2018-2025*, DHHS (NIOSH) Publication No. 2019-116 (Figure 1).



**Figure 1. NIOSH Nanotechnology Research Plan for 2018–2025. Image credit: NIOSH.**<sup>9</sup>

<sup>9</sup> <https://www.cdc.gov/niosh/docs/2019-116/default.html>