NNI Public Webinar:
Overview of U.S. Government Activities Addressing Micro- and Nanoplastics Issues
Session 2: Regulatory/Collaborations, June 6, 2023, 1-2:30 pm ET

1:00 Reconvening/introductory remarks (Anil Patri, FDA, moderator)
1:05 State Dept.: International Collaborations & Negotiations (Rob Wing)
1:15 EPA: Overview (Kay Ho)
1:25 FDA: Scientific Review (Stacey Wiggins)
1:35 ATSDR and NCEH: Overview (Custodio Muianga, Gaston Casillas, Max Zarate-Bermudez)
1:50 CPSC: Interagency Collaborations (Joanna Matheson)
2:00 Facilitated Q&A and discussion

Anil Patri
Director, Nanotechnology Core Facility. FDA
(Moderator)

Rob Wing
Deputy Director, Office of Environmental Quality, State/OES

Kay Ho
Environmental Research Scientist, Environmental Effects Research Lab, EPA

Stacey Wiggins
Science Advisor, Center for Food Safety & Applied Nutrition, FDA

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Gaston Casillas
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Max Zarate-Bermudez
Epidemiologist, CDC/NCEH

Joanna Matheson
Toxicologist, Program Manager, Nanotechnology, CPSC

HTTPS://WWW.NANO.GOV/PUBLICWEBINARS

(U) Galvanizing Global Action on Plastic Pollution

June 6, 2023

Robert Wing, Deputy Office Director
Office of Environmental Quality, Bureau of Oceans and International Environmental and Scientific Affairs (OES/ENV)

Road to INC on Plastic Pollution

- Growing recognition of plastic pollution as a global problem requiring international cooperation.

- Plastic pollution is priority issue in several international fora.

- March 2022, UNEA resolution 5/14, End plastic pollution: Towards an international legally binding instrument, launched negotiations on a global agreement on plastic pollution.

Overview of INC

- Intergovernmental negotiating committee (INC) launched in second half of 2022 with the goal of completing text by end of 2024.

- The scope of the instrument is specified as "plastic pollution, including in the marine environment".

- Countries agreed on an open-ended working group preparatory meeting and five sessions of the INC.

Giant Plastic Tap art installation at UNEA 5.2 by Benjamin Von Wong

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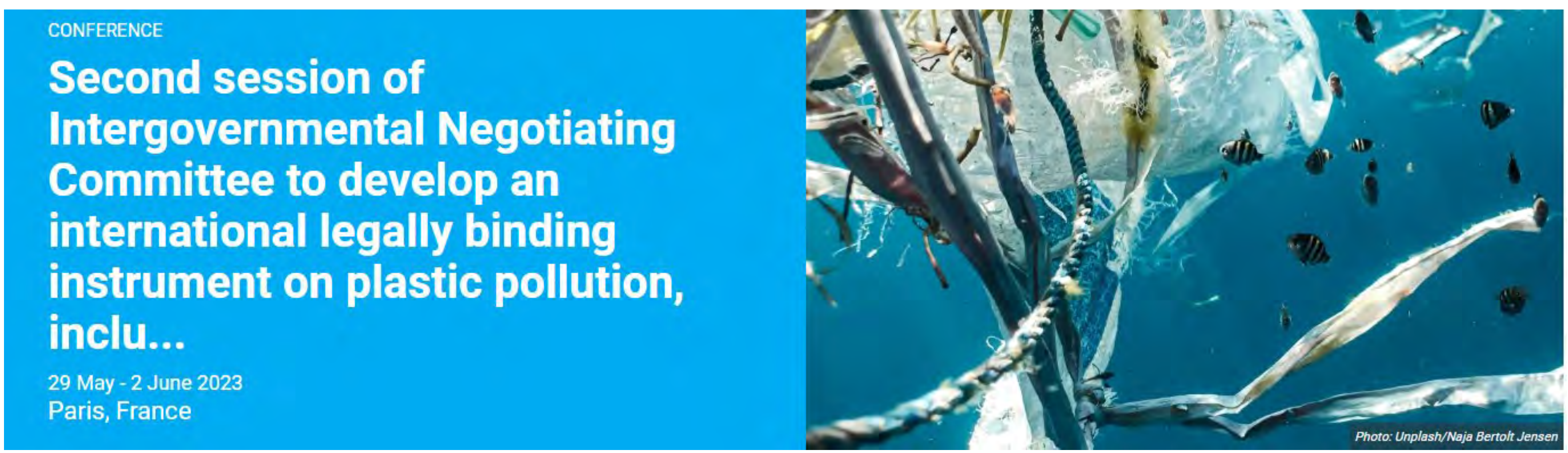
Outcomes from INC-1 & INC-2

Overarching themes:

- Countries made progress in considering the details of potential elements of the global agreement.
- The INC-2 outcome of requesting a draft instrument text is a step forward in meeting our goal to complete the text by the end of 2024.
- Heightened stakeholder interest and engagement



U.S. Approach to the Global Agreement

- The United States is committed to negotiating an ambitious, innovative, and inclusive global agreement.

- We need a global agreement that will facilitate rapid and meaningful progress.

- The agreement should include mechanisms to provide transparency, reporting, and monitoring of progress.

Photo: National Oceanic and Atmospheric Administration

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U.S. Approach to the Global Agreement

- Focus instrument on protection of human health and the environment from plastic pollution.

- Envisions ambitious provisions – including mix of obligations, commitments, and voluntary approaches – designed to prevent and reduce the amount of plastic entering the environment.

- Provisions should promote the sustainable production and consumption of plastic, increase plastic circularity, and strengthen the management of plastic waste through nationally determined actions.

- Instrument should allow for different solutions to address different problems at the various stages of the lifecycle, taking into account national circumstances.

U.S. Approach to the Global Agreement

- Parties develop and communicate national action plans that outline how the plan contributes to achieving the objective, including how it will implement obligations on preventing, reducing, or eliminating plastic pollution.

- National action plans foster ambitious action, where Parties identify and address sources of plastic pollution throughout the lifecycle of plastic in ways that are most suited to their national circumstances.

- Parties update their plans regularly (e.g., every five years) and demonstrate continued progress and increased ambition over time.

- Parties develop procedures to promote transparency and understanding regarding the elements of national action plans and their implementation.

Photo: National Oceanic and Atmospheric Administration

U.S. Approach to Global Agreement

- We also see a strong complementary role for partners and stakeholders by highlighting their actions to combat plastic pollution in a multistakeholder action agenda.

- We need substantial action from countries that are major producers, consumers, and plastic waste generators.

- National governments cannot solve this problem alone.

Photo: National Oceanic and Atmospheric Administration

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U.S. Efforts to Galvanize Action

- New U.S. Science Envoy on Plastic Pollution: Dr. LaShanda Korley, University of Delaware

- New Senior Director for Chemical Safety and Plastic Pollution at the Council on Environmental Quality (CEQ): Jonathan Black

INC-2 outcomes

- Held in Paris, May 29 – June 2, 2023. Strong engagement from city governments led by Mayor of Paris.

- State Department announced a new public-private partnership, EPPIC, or End Plastic Pollution International Collaborative, to galvanize actions to increase circularity of plastic. Key partners TBD.

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INC-2 outcomes

- US stakeholder meetings in Paris - over 100 attendees from environmental justice communities, environmental NGOs, waste pickers, scientists, and private sector participants from throughout the supply chain.

- Requested zero-draft text to inform negotiations at INC-3.
  - U.S. built bridges between countries with differing visions for the instrument.
  - Draft text will reflect different options expressed at INCs 1 and 2, and in country submissions ahead of INC-2, for elements of the instrument.

The Road Ahead

- INC-3 will be held November of 2023 in Nairobi

- INC- 4 in April of 2024 in Ottawa

- INC-5 in late 2024 in Republic of Korea

- **Thank you!**

US Environmental Protection Agency Micro/Nano-Plastic Research

EPA United States Environmental Protection Agency

Kay T. Ho
Office of Research and Development,
Center for Environmental Measurement and Modeling,
Atlantic Coastal Environmental Science Division , Narragansett, RI

National Nano Initiative

6 June 2023

US EPA-Organizational Chart

Office of the Administrator

- Air and Radiation
- Chemical Safety and Poll. Prevent
- Chief Financial Officer
- Enforcement Compliance Assurance
- General Counsel
- Inspector General
- International and Tribal Affairs
- Land and Emergency Management
- Mission Support
- Office of Research and Development
- Office of Water

ORD: Standardize Methods for Microplastics

Methods for Collection, Extraction and Identification of Nano- and Microplastics for Surface Water and Sediments

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Research Efforts:

1. Standardize extraction, identification and quantification methods for microplastics in sediment and surface waters.
2. Build capacity in EPA labs nationwide for microplastics identification and quantification.

ORD Research Areas- Method Development

Surface Waters

ASTM Methods –Standardization of Water Methods

- **ASTM D8332** Standard Practice for Collection of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers
- **ASTM D8333** Standard Practice for Preparation of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers Using Raman Spectroscopy, IR Spectroscopy, or Pyrolysis-GC/MS

Laser Directed Infrared Spectroscopy Methods – Surface Water

- Whiting, et al (2022). "A high-throughput, automated technique for microplastics detection, quantification, and characterization in surface waters using laser direct infrared spectroscopy" Anal. Bio. Chem. **414**(29): 8353-8364.

Sediments

- Cashman et al.(2020). Comparison of microplastic isolation and extraction procedures from marine sediments. MPB**159**: 111507.
- Cashman et al. (2022). Quantification of microplastics in sediments from Narragansett Bay, Rhode Island USA using a novel isolation and extraction method. MPB**174**: 113254.
- Langknecht et al. (2023). Comparison of two procedures for microplastics analysis in sediments based on an interlaboratory exercise. Chemo. **313**: 137479.
- El Khatib et al. (2023) Assessment of Filter Subsampling and Extrapolation for Quantifying Microplastics in Environmental Samples using Raman Spectroscopy accepted MPB-D-23-00792R1

ORD Research Areas- Method Development

Drinking Water

- Rochman et al (2022) Quantitative assessment of visual microscopy as a tool for microplastic research: recommendations for improving methods and reporting Chemo. 308:137479
- Keenan et al. (2023)Patterns of microparticles in blank samples: a study to inform best practices for microplastic analysis Chemo. In press
- Thorton et al. 2023 The influence of complex matrices on method performance in extracting and monitoring for microplastics Chemo. In press

Coral Reef Methods

- Hankins et al. (2018) Scleractinian coral microplastic ingestion: Potential calcification effects, size limits, and retention. Mar.Poll. Bull. 135:587-593.
- Hankins, et al. (2021). Microplastics impair growth in two atlantic scleractinian coral species, Pseudodiploria clivosa and Acropora Environ. Poll. 275. 116649

Effects Methods

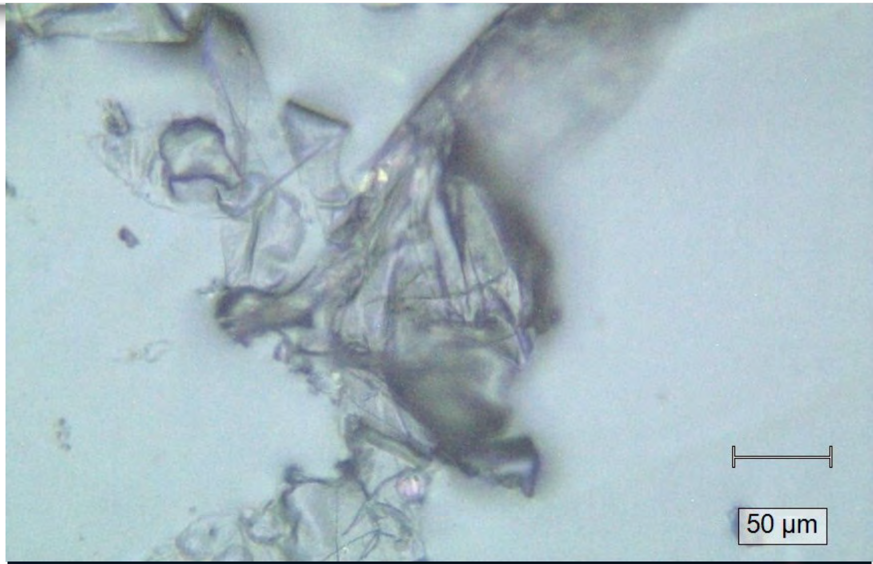
Giroux et al. Using eRNA/eDNA metabarcoding to detect community-level impacts of nanoplastic exposure to benthic estuarine ecosystems (2023) accepted Envrion. Poll.

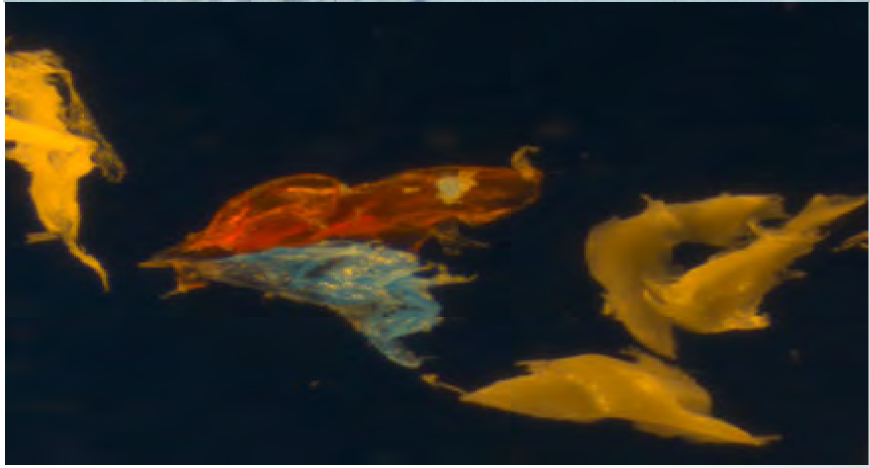
Analytical Methods Lessons Learned

- QA/ QC
- Smaller the particle, the more difficult the analysis
- Complex matrix, difficult analysis
- Proscribed methods may increase accuracy and precision
- Common spectroscopic methods are accurate (once the particle has been extracted)
- There is still work to be done to develop reproducible methods across laboratories.

ORD Future Directions 2023- 2026

- Methods for smaller sized particles- nanoplastics.
- Move towards quantifying polymer concentration (pyrolysis GC/MS) rather than particle enumeration—spectroscopic methods (Raman, FTIR).
  - Pyrolysis- polymer identification, nanoplastics, faster.
  - Still need for particle characterization, early days!
- Human Health and Ecological Effects.
- Microplastic fate in septic systems
- 6-PPD Quinone and Tire Wear Particles.
  - Effects
  - Green infrastructure





OW Research: Microplastic Expert Workshop, Beach Protocol

- **Microplastic Expert Workshop Update**
  - EPA Trash Free Waters Program convened an expert workshop 2017 to identify and prioritize scientific information needed to understand the risks posed by microplastics.
  - Update 2022
    - Analytical methods needed for complex matrices and nanoparticles
    - Source identification and factors that influence fate of MP in the environment.
    - Toxicity evaluations with environmentally realistic conc. and particles including fibers https://www.epa.gov/system/files/documents/2021-12/tfw-report-on-priority-microplastics-research-needs_0.pdf

- **Microplastic Beach Protocol (2021)**
  - Community scientists collect data on microplastic pollution along beaches and shorelines.
  - Volunteers can collect data can be used to characterize current levels of microplastics pollution https://www.epa.gov/trash-free-waters/best-management-practices-tools#1

OW: United States Federal Plan to Address Microfiber Pollution. SOS 2.0 Act

Federal Plan Goals

- Goal 1: Support microfiber research
- Goal 2: Prevent & reduce microfibers
- Goal 3: Capture microfibers
- Goal 4: Minimize microfiber toxicity
- Goal 5: Share microfiber knowledge

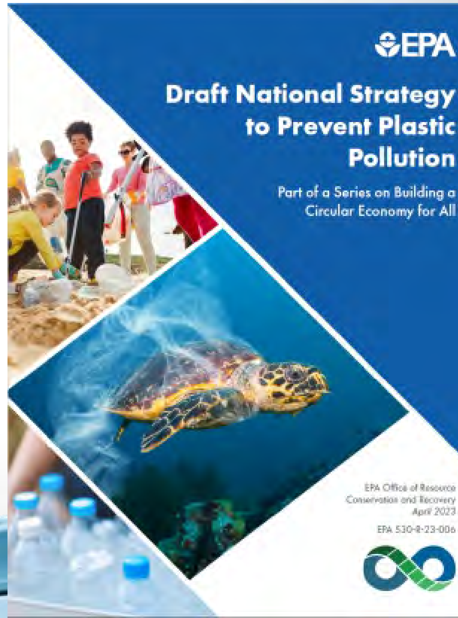
OW: Tire Wear Particle Roundtable, National Strategy

- **Tire Wear Particle (TWP) Roundtable Discussion (2022)**
  - **EPA Trash Free Waters Program** convened roundtable meetings for stakeholders to address TWP issues
    - Research-need data on almost all aspects of TWP
    - Research solutions- variety of approaches
    - Cost and Funding, Education

  https://www.epa.gov/trash-free-waters/science-case-studies#Tire

- **Draft National Strategy to Prevent Plastic Pollution (Comment period June 16)**
    - Reduce pollution during plastic production.
    - Improve post-use materials management
    - Prevent trash and micro/nanoplastics from entering waterways and remove escaped trash from the environment.

  https://www.epa.gov/circulareconomy/draft-national-strategy-prevent-plastic-pollution#summary



EPA SBIR Support for Microplastics Technologies

AMERICA'S SEED FUND
SBIR
POWERED BY
EPA

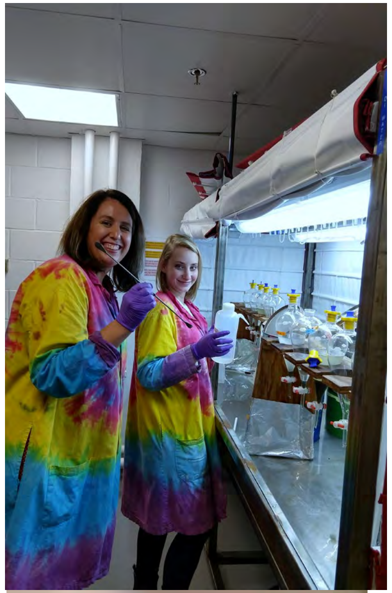
- EPA's SBIR Program supports small businesses to develop and commercialize innovative environmental technologies
- Focused on microplastics collection, quantification and characterization
- Projects:
  - Lucendi, Inc., Cost-effective, portable and automated platform for microplastics characterization
  - Triple Ring Technologies, A fieldable, portable, reagent-free microplastic sensor enabling rapid readout and modular operation
  - Sporian, A high-speed, low cost, machine learning enhanced, hyperspectral imaging system for improved identification of microplastics

Richards.April@epa.gov

Collaborations: It Takes a Village

- National Institute of Standards and Technology
- United States Geological Survey
- Food and Drug Administration
- Center for Disease Control
- National Oceanic and Atmospheric Administration
- Department of Energy
- U.S. Government Nanoplastics Interest Group
- Interstate Technology and Regulatory Council
- California Department of Health
- Southern California Coastal Water Research Project
- Asia-Pacific Economic Cooperation

USEPA Microplastics Research Team



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FDA: Scientific Review of Microplastics in Food

National Nanotechnology Initiative Public Webinar June 6, 2023

Stacey Wiggins, Ph.D.
Science Advisor
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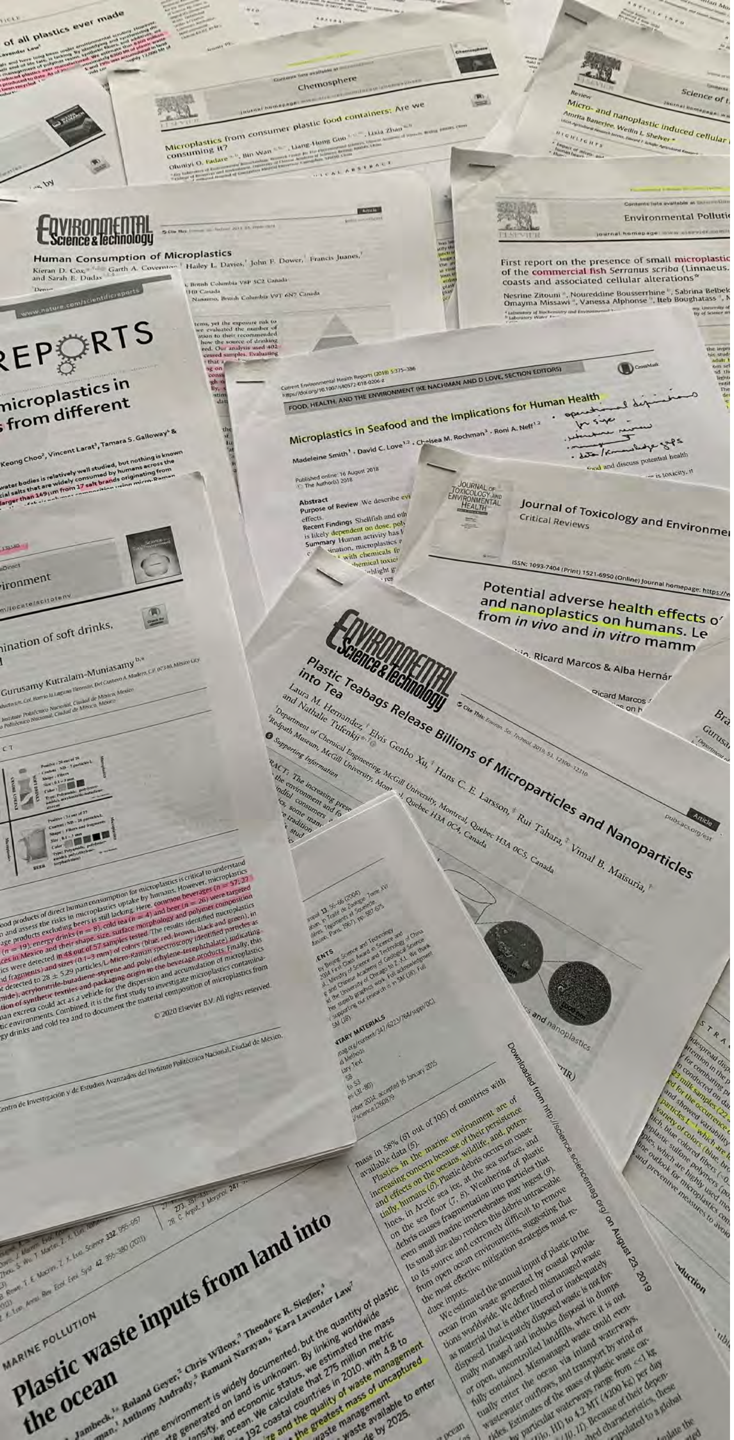
Food & Drug Administration

MISSION

The **FDA** is responsible for protecting the public health by assuring the **safety, efficacy, and security** of human and veterinary drugs, biological products, medical devices, our nation's **food supply**, cosmetics, and products that emit radiation.

Micro- & Nanoplastics in Foods Group

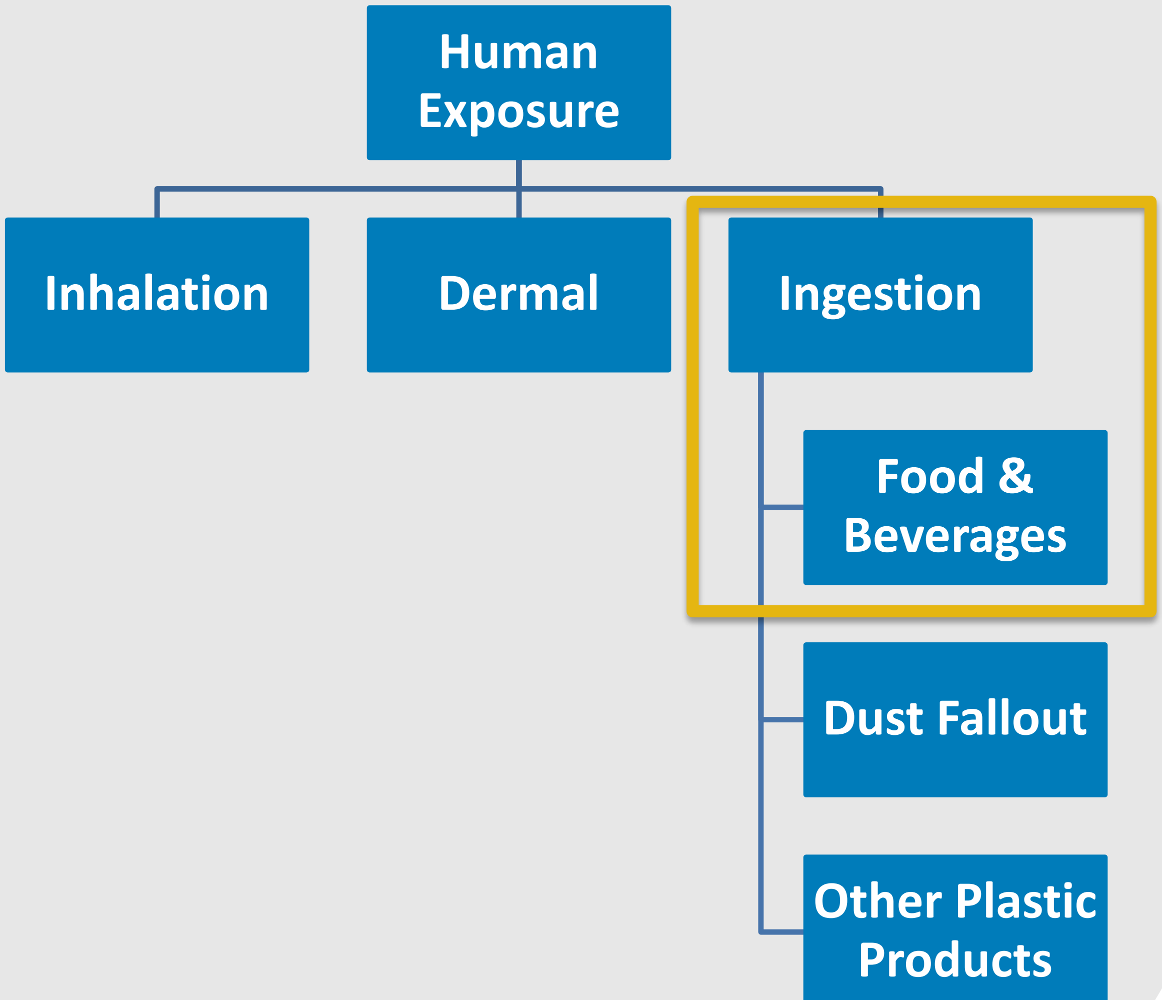
- Center for Food Safety & Applied Nutrition
  - Office of Food Safety
  - Office of Regulatory Science
  - Office of Food Additive Safety
  - Office of Cosmetics and Colors
  - Office of Applied Research and Safety Assessment
  - Office of International Engagement
  - Office of the Center Director
- Center for Veterinary Medicine
- Center for Tobacco Products
- National Center for Toxicological Research
- Office of Regulatory Affairs
- Office of Policy, Legislation, and International Affairs



Scientific Literature Review

- Reviewed >200 publications
- Example Topics:
  - polymer characteristics
  - plastic pollution
  - plastic weathering and fragmentation
  - micro- and nanoplastics in foods
  - potential health impacts
  - methodology

Exposure Pathways



WHO 2019; Revel et al. 2018

Microplastics Reported in Food & Beverages

Fish	Mollusks	Crustaceans	Bottled Water
Drinking Water	Salt	Honey	Sugar
Beer	Poultry	Nori	Milk
Tea	Soft Drinks	Energy Drinks	

Example Polymers Reported in Food

Drinking water

- PET, PP

Seafood

- PET, PA, PE, PEMA, PEVA, PUR

Milk

- PES, PSU

Salt

- PET, PE

Tea

- PET, PA

Seafood

- Reports of microplastics in seafood are predominant
- Reported in fish, mollusks, and crustaceans
- Reliable quantitative data are limited due to method challenges

Methodology Considerations

- Lack of standardized definitions or methods
- Lack of appropriate standards
- Lack of standardized reporting metrics
  - Particle concentrations vs mass
- Not all studies used methods that could confirm microplastics
- Lack of quality control
- Challenge for reliable, quantitative data for comparison across studies

Methodology Considerations

"One challenge in this area is that there are different sampling, sample preparation, detection, and characterization methods in use, some of which may not be appropriate or reliable for detecting microplastics."

NASEM, 2020

Potential Impact on Human Health

Health **Risk** is a function of:

Hazard and **Exposure**

Occurrence in Foods/Exposure

Toxicity

>150 µm Not absorbed	<150 µm May be absorbed	≤0.3% Limited translocation	→	Gut to circulatory

Microplastics Excretion

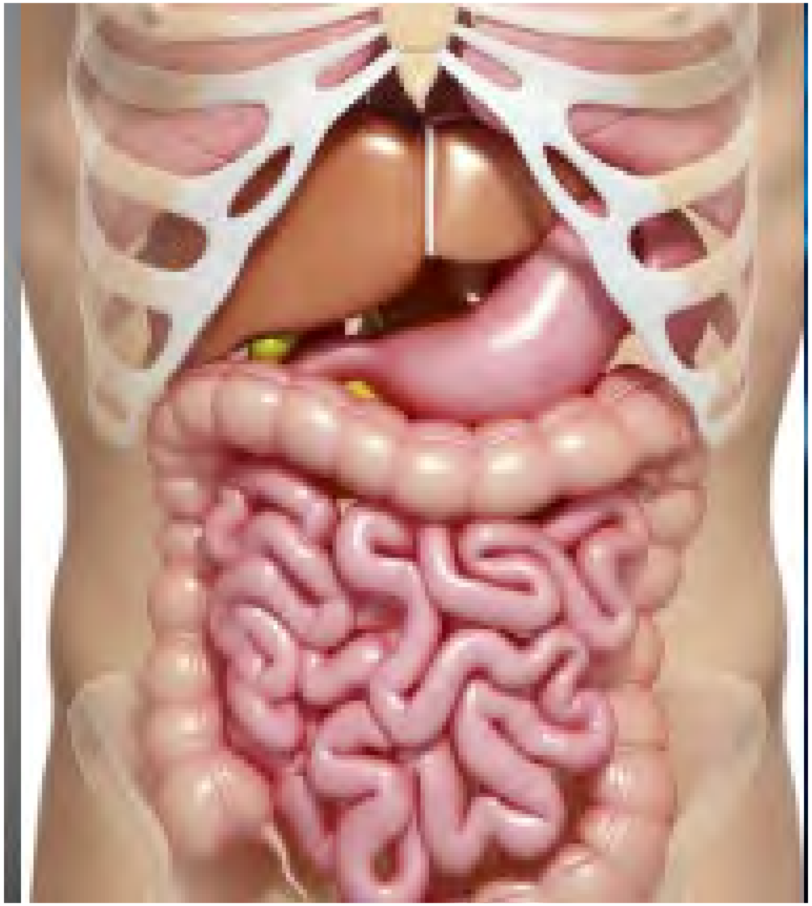
8/8

Human stool samples

Positive for microplastics

Median of 20 microplastic particles per 10 g stool

PP and PET, most abundant



Schwabl et al. 2019

Limited Toxicity Studies

SCIENTIFIC REPORTS

OPEN

Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure

Received: 10 October 2016
Accepted: 27 March 2017
Published: 24 April 2017

Yongfeng Deng[1], Yan Zhang[1], Bernardo Lemos[2] & Hongqiang Ren[1]

Energy and lipid metabolism
Oxidative stress
Neurotoxic

Deng et al. 2017

Archives of Toxicology (2019) 93:1817–1833
https://doi.org/10.1007/s00204-019-02478-7

REGULATORY TOXICOLOGY

Uptake and effects of orally ingested polystyrene microplastic particles in vitro and in vivo

Valerie Stock[1] · Linda Böhmert[1] · Elisa Lisicki[1] · Rafael Block[1] · Julia Cara-Carmona[1] · Laura Kim Pack[1] · Regina Selb[1] · Dajana Lichtenstein[1] · Linn Voss[1] · Colin J. Henderson[2] · Elke Zabinsky[3] · Holger Sieg[1] · Albert Braeuning[1] · Alfonso Lampen[1]

Minor uptake observed
Absence of histological lesions
Absence of inflammatory response

Stock et al. 2019

Conclusions

- Microplastics have been reported in a range of foods
- There are limitations in drawing quantitative conclusions due to methodology challenges
- Polymers in seafood exhibited the greatest variability, compared to other foods
- Polymer types in bottled water may have been associated with processing and packaging
- There is a lack of evidence clearly supporting that microplastics impact human health

Knowledge Gaps

- Standard definitions and fit-for-purpose metrics
- Standards and reference materials
- Standardized sample collection and preparation techniques
- Standardized detection methods
- Real-world mixtures
- Accurate/quantitative data on exposure via food
- Exposure estimates on wide range of foods per plastic type
- Understanding of fate and transport in the body
- Understanding of dosimetry
- Understanding of potential toxicity to humans

FDA Activities

- Stay apprised of the latest science
- Interagency Participation
  - U.S. Government Nanoplastics Interest Group
  - Led by the State Department to develop the U.S. position on plastic pollution for the United Nations
  - EPA-led workshops to develop the Report on Microfiber Pollution, a requirement under the Save Our Seas 2.0 Act
- Presentations
  - CVM One Health Today
  - NASEM Food Forum
  - White House Council on Environmental Quality (CEQ) Briefing

FDA U.S. FOOD & DRUG ADMINISTRATION

NCEH/ATSDR Microplastics and Human Health Working Group Update

National Nanotechnology Initiative - Public Webinar

June 6, 2023

Custodio V. Muianga, PhD, MPH, CHMM
Max Zarate-Bermudez, PhD, MPH, MSc
Gaston Casillas, PhD

Disclaimer

- The findings and conclusions in this presentation have not been formally disseminated by the Centers for Disease Control and Prevention nor by any agency of the United States government, and they should not be interpreted as the opinion nor policy of any agency.

Outline

- Brief overview of NCEH/ATSDR Microplastics and Human Health Working Group
- Activities updates and data gaps and needs
  - Context and Exposures and health risk assessment (Custodio)
  - Human exposure to Microplastics in Water and Health Effects (Max)
  - Microplastics Systematic Evidence Mapping (Gaston)

NCEH/ATSDR Microplastics and Human Health Working Group:

- ATSDR/NCEH interdisciplinary working group focusing on
  - Microplastics, including nanoplastics and other nanomaterials
  - Better understanding the occurrence of microplastics in the environment, routes of exposures, and potential health effects
- Meets monthly to discuss project updates, presentations, and participation in scientific events of interest that are internal or external to the U.S. government

Microplastics and Human Health Working Group Vision

- Our science and resources energize communities and institutions to stop harmful microplastic and nanoplastic exposures in our environment.

Microplastics and Human Health Working Group Strategic Objectives

- Define health risks
- Constructive partnerships
- Empower solutions

Photo Source: CDC Public Health Image Library

Selected Achievements and Ongoing Work

Review

A review of data for quantifying human exposures to micro and nanoplastics and potential health risks

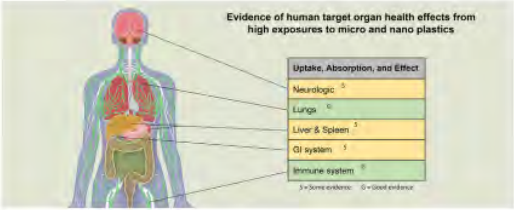
Gregory M. Zarus [a,*], Custodio Muianga [a], Candis M. Hunter [b], R. Steven Pappas [b]

[a] Agency for Toxic Substances and Disease Registry, 4770 Buford Highway, Atlanta, GA 30341, USA
[b] National Center for Environmental Health, 4770 Buford Highway, Atlanta, GA 30341, USA

H I G H L I G H T S

- Humans are exposed to microplastics via ingestion, inhalation, and absorption.
- There is little exposure information on nanoplastics and most foods.
- There is evidence of uptake, absorption, translocation, and effect.
- Impacts reported on the immune, respiratory, gastro-intestinal, and hepatic systems.
- Effects and target organs are dependent on plastic type, size, and amount.

G R A P H I C A L   A B S T R A C T



A R T I C L E   I N F O

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Environmental exposures
Biomarkers
Health effects

A B S T R A C T

Plastic debris have been shown to degenerate to particle sizes that can be transported in air, water, and food. Small particles are documented to enter and exit our bodies and translocate to and from some internal organs. Health effects on respiratory, hepatic, immune, and gastrointestinal systems have been reported in humans and other mammals in response to elevated particle or fiber exposures. These health effects differed by plastic type and size, and there was evidence of dose response for a few health endpoints. We conducted a systematic word search and reviewed published literature to identify microplastic and nanoplastic studies that quantified exposure via the ingestion, inhalation, and subcutaneous absorption (not dermal) exposure pathways; identified translocation, internal dose, and associations with health effects and markers related to exposures to specific sizes and types of plastics. We identified the data gaps in relating exposure data to health effects and biomarkers, most notably the lack of characterization of plastic particles and fibers smaller than 10 µm in most media.

Published by Elsevier B.V.

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microplastics MDPI

Review

Microplastics Scoping Review of Environmental and Human Exposure Data

Gaston Casillas [1,*], Brian Charles Hubbard [1], Jana Telfer [1], Max Zarate-Bermudez [1], Custodio Muianga [1], Gregory M. Zarus [1], Yulia Carroll [1], April Ellis [2] and Candis M. Hunter [1]

1 Centers for Disease Control and Prevention, Atlanta, GA 30341, USA
2 College of Marine Science, University of South Florida, 830 1st St S, St. Petersburg, FL 3370, USA
* Correspondence: qan7@cdc.gov

Abstract: Scientific studies of microplastics have expanded since 2015, propelling the topic to the forefront of scientific inquiry. Microplastics are ubiquitous in the environment and pose a potential risk to human health. The purpose of this review is to organize microplastics literature into areas of scientific research, summarize the state of the literature and identify the current data gaps in knowledge to promote a better understanding of human exposure to microplastics and their potential health effects. We searched for published literature from eight databases. Our search focused on three categories: (1) microplastics in the environment, (2) adsorption and absorption of chemicals to microplastics, and (3) human exposure to microplastics in the environment. We screened all abstracts to select articles that focused on microplastics. We then screened the remaining articles using criteria outlined in a questionnaire to identify and assign articles to the three scoping review categories. After screening abstracts, we selected 1186 articles (19%) to thoroughly assess their appropriateness for inclusion in the final review. Of the 1186 articles, 903 (76.1%) belonged to the environmental category, 268 (22.6%) to the adsorption and absorption category, and 16 (1.3%) to the human exposure category. Water was the most frequently studied environmental medium (440 articles). Our assessment resulted in 572 articles selected for the final review. Of the 572 publications, 268 (48.2%) included a geographic component and 110 (19.2%) were the product of literature reviews. We also show that relatively few publications have investigated human health effects associated with exposures to microplastics.

Keywords: scoping review; microplastics; environmental concentration; literature review

check for updates

Citation: Casillas, G.; Hubbard, B.C.; Telfer, J.; Zarate-Bermudez, M.; Muianga, C.; Zarus, G.M.; Carroll, Y.; Ellis, A.; Hunter, C.M. Microplastics

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Zarus et al. 2022 Review of Data for Quantifying Human Exposures to Micro and Nanoplastics and Potential Health Risks - PMC (nih.gov)

Casillas et al. 2023. Microplastics | Free Full-Text | Microplastics Scoping Review of Environmental and Human Exposure Data (mdpi.com)

Microplastics in Human Specimens and Biomonitoring Data

- Preliminary results of ongoing systematic literature review (2014 – 4/2023)
- In total 9,017 human tissues and body fluids samples for MPs/NPs testing from 4,914 people
  - At least 656 women (~ 13.4%)
  - 21 infants (< 1.0%)
  - More than 30 cadavers (<1.0%)
- All the 30 studies reported human subject ethics review approvals for recruitment
- 50 plastic polymer type MPs/NPs* were identified and quantified in human body
- Additional exposure parameters are needed to complete both internal dose and body burden calculations

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*Microplastics (MPs) plastic particles ranging in size from 5 mm to 100 nm) and nanoplastics (NPs) plastic particles smaller than 100 nm.

Systematic review on human exposure to microplastics in water and potential health effects

- Protocol registered PROSPERO (ID: CRD42021278806)
- Review of the 1990-2022 scientific literature, focus on:
  - Micro- and nano-plastics occurrence in freshwater sources, drinking water, and drinking water-based beverages
  - Scientific-technological advances to remove MPs/NPs from water systems
  - Routes of human exposures
  - Potential health effects, including lab-scale studies

Systematic review on human exposure to microplastics in water and potential health effects

- Searched eight databases: 6,472 scientific publications
- Using Covidence we completed the following:
  - Screened 6,417 titles and abstracts, and
  - Reviewed 744 full texts
- Currently, completing data extraction from 253 publications
- Goal: publish and present findings

Microplastics Systematic Evidence Mapping (SEM) Update (Gaston Casillas)

First iteration of the SEM with three interactive tables

- Categories and questions heat map
- References table
- Literature type percentage table

Microplastics SEM | Tableau Public

Thank you!

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NCEH/ATSDR Microplastic and Human Health Working Group

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- Brian Hubbard, MPH
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- Custodio Muianga, PhD, MPH
- Katie Stalling, PhD
- Steve Pappas, PhD
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- John Sarisky, MPH
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United States
Consumer Product Safety Commission

Interagency Collaborations

Microplastics and nanoplastics

Joanna Matheson, Ph.D.
Health Sciences Directorate

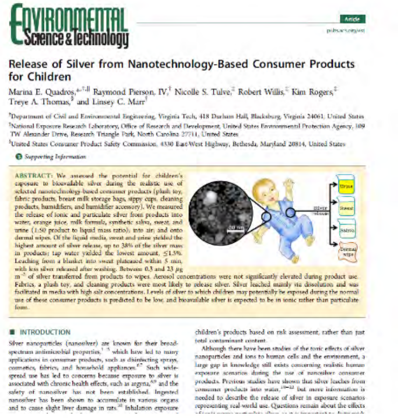
Disclaimer: *This presentation was prepared by CPSC Staff and may not necessarily reflect the views of the Commission.*

Consumer Product Safety Commission (CPSC)

- Independent, federal regulatory agency;
  est. 1972
- Mission is to reduce unreasonable risks of injury associated with consumer products
- Jurisdiction includes thousands of consumer products (generally excluding cars, airplanes, food, medical devices, tobacco, and pesticides)

National and International Collaborations

- DOD, EPA, FDA, NIOSH, NIST, NLM, NNCO, NSF
- NanoWIR^{2}ES: NanoWire intelligent re-design and recycling for environmental safety; Safe Implementation of Innovative Nanoscience & Nanotechnology (SIINN) program
- Risk Assessment for Manufactured Nanoparticles Used in Consumer Products (RAMNUC); assessing inhalation exposure to airborne nanoparticles and their agglomerates from the use of sprays (*i.e.*, nano zinc and silver).


Environmental Science & Technology
Article
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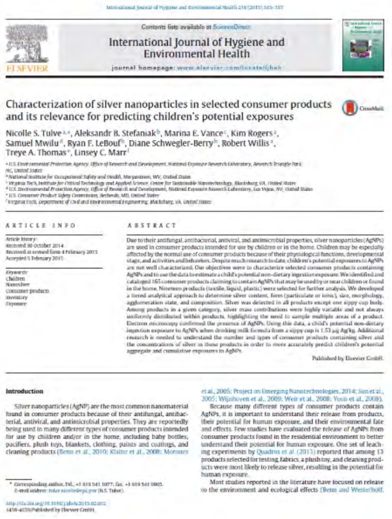
Release of Silver from Nanotechnology-Based Consumer Products for Children

Marina E. Quadros, Raymond Pierson, IV, Nicolle S. Tulve, Robert Willis, Kim Rogers, Treye A. Thomas, and Linsey C. Marr

Department of Civil and Environmental Engineering, Virginia Tech, 418 Durham Hall, Blacksburg, Virginia 24061, United States
National Exposure Research Laboratory, Office of Research and Development, United States Environmental Protection Agency, 109 TW Alexander Drive, Research Triangle Park, North Carolina 27711, United States
United States Consumer Product Safety Commission, 4330 East-West Highway, Bethesda, Maryland 20814, United States

ABSTRACT: We assessed the potential for children's exposure to bioavailable silver during the realistic use of selected nanotechnology-based consumer products (plush toy, fabric products, breast milk storage bags, sippy cups, cleaning products, humidifiers, and humidifier accessory). We measured the release of ionic and particulate silver from products into water, orange juice, milk formula, synthetic saliva, sweat, and urine (1:50 product to liquid mass ratio); into air; and onto dermal wipes. Of the liquid media, sweat and urine yielded the ...


International Journal of Hygiene and Environmental Health

Characterization of silver nanoparticles in selected consumer products and its relevance for predicting children's potential exposures

Nicolle S. Tulve, Aleksandr B. Stefaniak, Marina E. Vance, Kim Rogers, Samuel Mwilu, Ryan F. LeBouf, Diane Schwegler-Berry, Robert Willis, Treye A. Thomas, Linsey C. Marr

Collaborations: Methods, Exposures

- NIOSH and Harvard: Laser printer-emitted engineered nanoparticles.
  - Effects of laser printer-emitted nanoparticles on cytotoxicity, chemokine expression, reactive oxygen species, DNA methylation, and DNA damage: a comprehensive *in vitro* analysis in human small airway epithelial cells, macrophages, and lymphoblasts.
- NIST: Method development and modification for appropriateness in evaluating nanomaterials presence and toxicity.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CENTER FOR NANOTECHNOLOGY
AND NANOTOXICOLOGY
http://hsph.harvard.edu/nano

Progress report - Year 1:
"Physicochemical, morphological and toxicological characterization of printer emitted particles (PEPs)"

September 23, 2013

Exposure Assessment of Carbon Nanotubes in Sports Equipment

Report of Analysis for the CPSC-NIST Interagency Agreement # CPSC-I-08-0008; Mod#3

May 15, 2012

Performed by:

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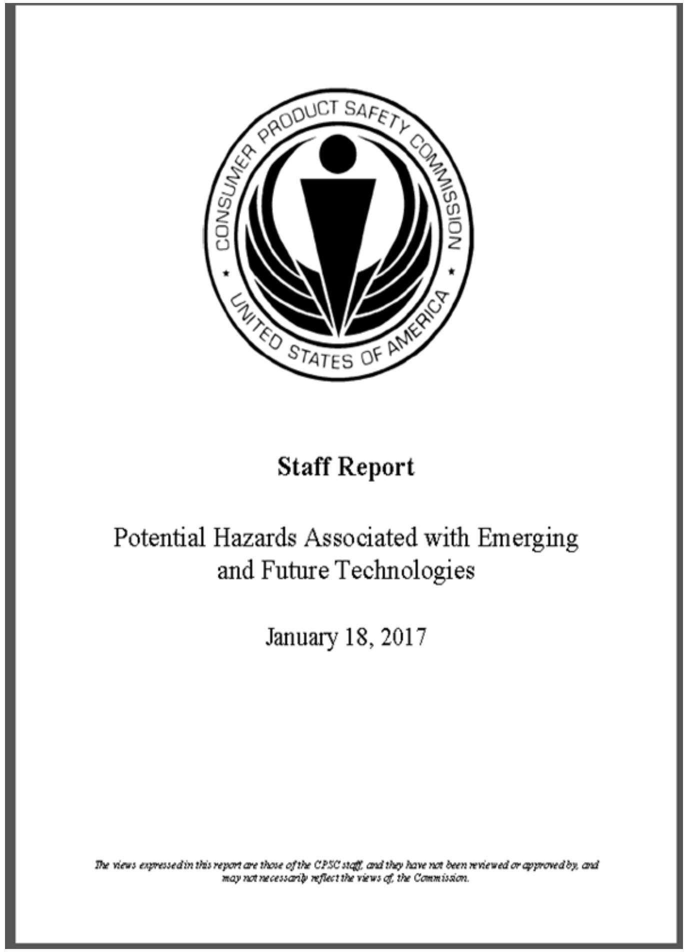
PULMONARY AND CARDIOVASCULAR RESPONSES OF RATS TO INHALATION OF SILVER NANOPARTICLES

3D Printing

- CPSC Report on Emerging Consumer Products
- Overview of potential emerging consumer products and technologies
- Technological and societal trends likely to influence consumer goods market
- Potential consumer safety issues and opportunities for enhancing product safety



CONSUMER PRODUCT SAFETY COMMISSION
UNITED STATES OF AMERICA

Staff Report

Potential Hazards Associated with Emerging and Future Technologies

January 18, 2017

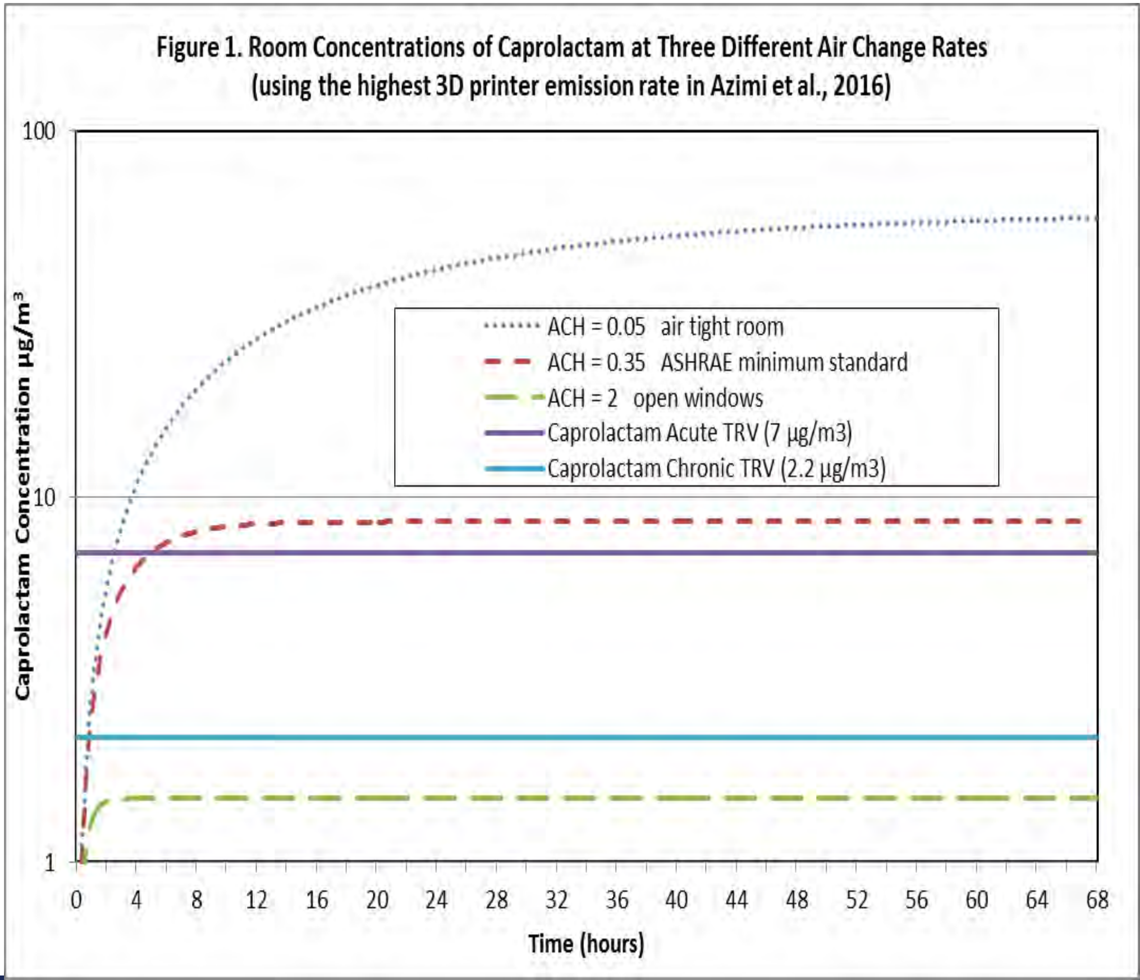
The views expressed in this report are those of the CPSC staff, and they have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

Exposure and Potential Health Risks

- Consumer at-home use of 3D printing is increasing rapidly and expected to reach USD 30 billion by 2022.
  - Adult hobbyists and home-based manufacturers account for most home use; some are marketed for use by children.
- Broad range of filaments available (*e.g*., acrylonitrile butadiene styrene, high impact polystyrene, polylactic acid, thermoplastic elastomer, nylon)
- Consumers can make their own filaments
- Nanomaterials (CNTs) may be used in these filaments

Preliminary Risk Estimate from 3D Printer Emissions

- Volume = 18.1 m^3 with variable air change rates (ACH, 0.05, 0.35, and 2 h-1).
- VOC emission rates were used to estimate room VOC concentrations in a one-zone model evaluated at time intervals from 0.1 to 68 hours.
- Continuous printing for 68H
- No VOCs entering the room with dilution air
- No reactive decay of VOCs, and no VOC sinks.



EPA: Method Development - Elemental Composition and Concentrations

- High-pressure, high-temperature method was identified as the most robust technique for inorganic element extraction
- ABS, PLA, blends, metal thermoplastics
- Elements linked to production processes or desired properties of the filaments

Research Article

Variability in the inorganic composition of colored acrylonitrile–butadiene–styrene and polylactic acid filaments used in 3D printing

Derek M. Peloquin[1,2] · Logan N. Rand[1] · Eric J. Baumann[1,2] · Ali Gitipour[1,3] · Joanna Matheson[4] · Todd P. Luxton[1]

Received: 26 September 2022 / Accepted: 9 November 2022
Published online: 08 December 2022

Abstract
Fused filament fabrication is a 3D printing technique that has gained widespread use from homes to schools to workplaces. Thermoplastic filaments, such as acrylonitrile–butadiene–styrene (ABS) and polylactic acid (PLA), are extruded at temperatures near their respective glass transition temperature or melting point, respectively. Little has been reported on the inorganic elemental composition and concentrations present in these materials or the methods available for extracting that information. Because inorganic constituents may be included in the aerosolized particulates emitted during the printing process, identifying elements that could be present and at what specific concentrations is critical. The objective of the current research is to determine the range of metals present in thermoplastic filaments along with their relative abundance and chemical speciation as a function of polymer type, manufacturer, and color. A variety of filaments from select manufacturers were digested using a range of techniques to determine the optimal conditions for metal extraction from ABS and PLA polymers. The extraction potential for each method was quantified using by ICP-MS analysis. When possible, further characterization of the chemical composition of the filaments was investigated using X-ray Absorption spectroscopy to determine chemical speciation of the metal. Optimal digestion conditions were established using a high temperature, high pressure microwave-assisted acid digestion method to produce the most complete and repeatable extraction results. The composition and abundance of metals in the filaments varied greatly as a function of polymer, manufacturer, and color. Potential elements of concern present in the filaments at elevated concentration included that could pose a respiratory risk included Si, Al, Ti, Cu, Zn, and Sn. XAS analysis revealed a mixture of metal oxides, mineral, and organometallic compounds were present in the filaments that were being used to increase opaqueness impart color (dyes), polymeric catalysts, and flame retardants. This work shows that a variety of metals are present in the starting materials used for 3D printing and depending on their partitioning into 3D printed products and byproducts as well as the exposure route, may pose a health risk which merits further investigation.

Keywords Fused filament fabrication · Digestion methods · Inorganic composition · Metal speciation · Polymer inorganic composition · 3D printing · Additive manufacturing

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s42452-022-05221-7.

Todd P. Luxton, luxton.todd@epa.gov | [1]Center for Environmental Research and Emergency Response, Office of Research and Development, U.S. Environmental Protection Agency, 5995 Center Hill Ave, Cincinnati, OH 45224, USA. [2]Present Address: Forensic Chemistry Center, Office of Regulatory Affairs, U.S. Food and Drug Administration, Cincinnati, OH 45237, USA. [3]Present Address: Center for Environmental Measurements and Modeling, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC, USA. [4]Office of Hazard Identification and Reduction, U.S. Consumer Product Safety Commission, Bethesda, MD, USA.

NIST: Effects of 3D Printing Parameters on Particulate Release During 3D Printing

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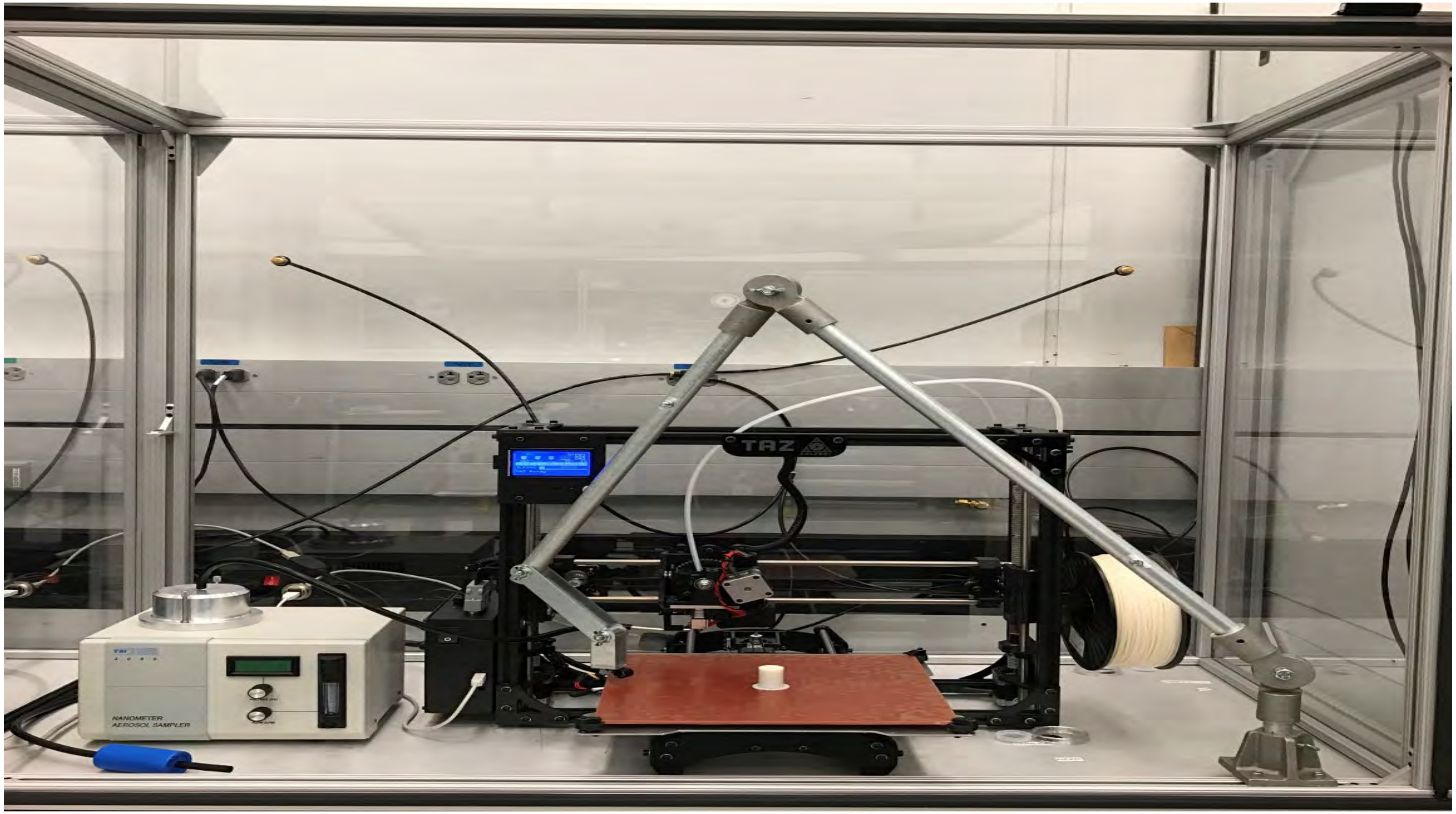
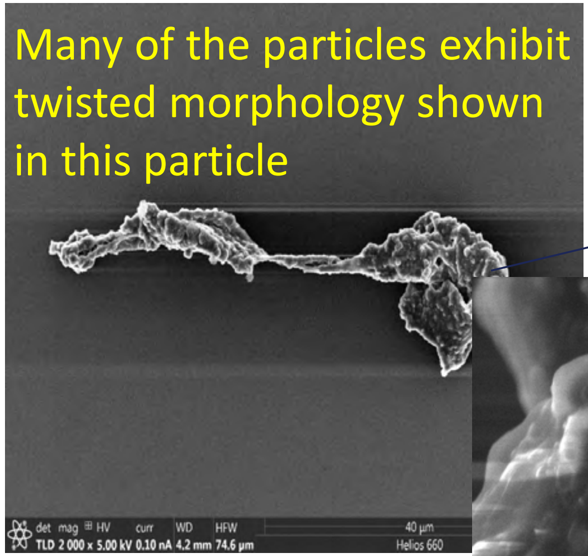
UNITED STATES

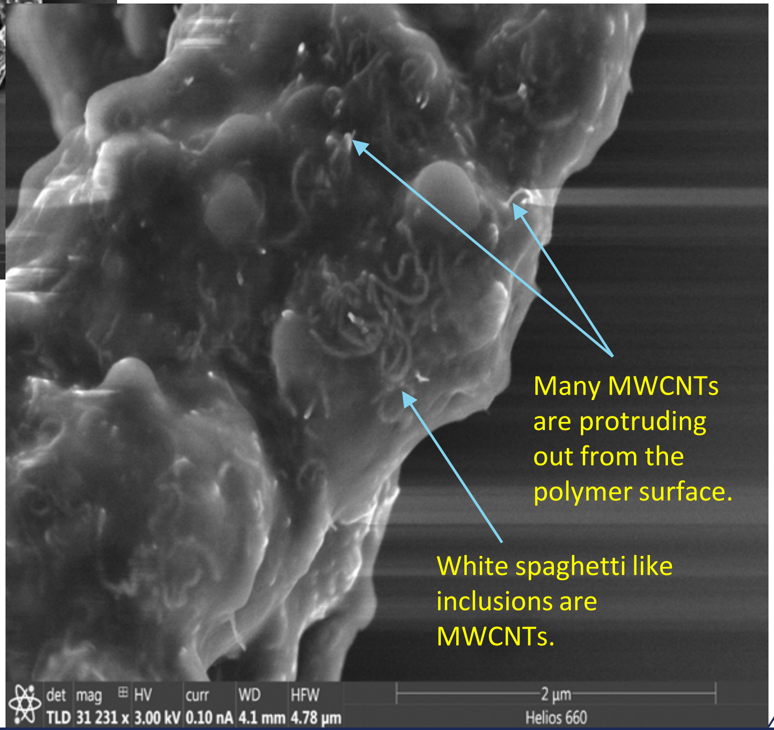


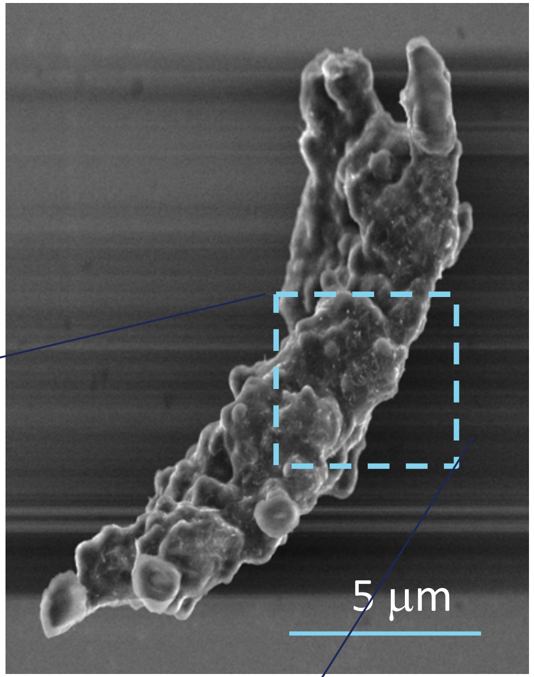
- Adjustable sampling port positions
- Electrostatic precipitator-based particle collection
- Carbon nanotube ABS filament

NIST: Effects of 3D Printing Parameters on Particulate Release During 3D Printing

- Evaluated polymeric (ABS) and nano-composite (ABS + MWCNT) systems
- Embedded MWCNTs detected, free CNTs not detected
- Fractional factorial design employed to assess released particle exposure
- Proximity and filament type resulted in the biggest differences

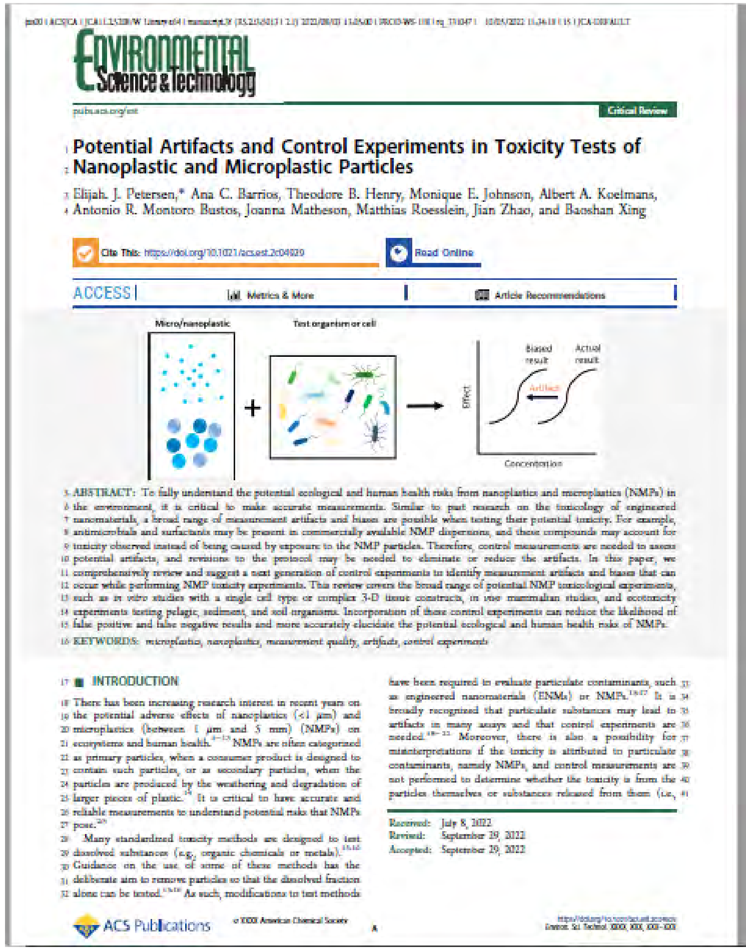






NIST: Potential Artifacts and Biases and Need for Control Experiments

- Antimicrobials and surfactants may be present in commercially available nano- and microplastic dispersions
- Sample handling, testing (dosimetry, bioavailability, agglomeration, nutrient depletion)


Environmental Science & Technology
pubs.acs.org/est
Critical Review

Potential Artifacts and Control Experiments in Toxicity Tests of Nanoplastic and Microplastic Particles

Elijah J. Petersen,* Ana C. Barrios, Theodore B. Henry, Monique E. Johnson, Albert A. Koelmans, Antonio R. Montoro Bustos, Joanna Matheson, Matthias Roesslein, Jian Zhao, and Baoshan Xing

Cite This: https://doi.org/10.1021/acs.est.2c04929
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ABSTRACT: To fully understand the potential ecological and human health risks from nanoplastics and microplastics (NMPs) in the environment, it is critical to make accurate measurements. Similar to past research on the toxicology of engineered nanomaterials, a broad range of measurement artifacts and biases are possible when testing their potential toxicity. For example, antimicrobials and surfactants may be present in commercially available NMP dispersions, and these compounds may account for toxicity observed instead of being caused by exposure to the NMP particles. Therefore, control measurements are needed to assess potential artifacts, and revisions to the protocol may be needed to eliminate or reduce the artifacts. In this paper, we comprehensively review and suggest a next generation of control experiments to identify measurement artifacts and biases that can occur while performing NMP toxicity experiments. This review covers the broad range of potential NMP toxicological experiments, such as in vitro studies with a single cell type or complex 3-D tissue constructs, in vivo mammalian studies, and ecotoxicity experiments testing pelagic, sediment, and soil organisms. Incorporation of these control experiments can reduce the likelihood of false positive and false negative results and more accurately elucidate the potential ecological and human health risks of NMPs.

KEYWORDS: *microplastics, nanoplastics, measurement quality, artifacts, control experiments*

INTRODUCTION

Received: July 8, 2022
Revised: September 19, 2022
Accepted: September 19, 2022

ACS Publications

NIOSH: Characterization and Toxicity Assessment

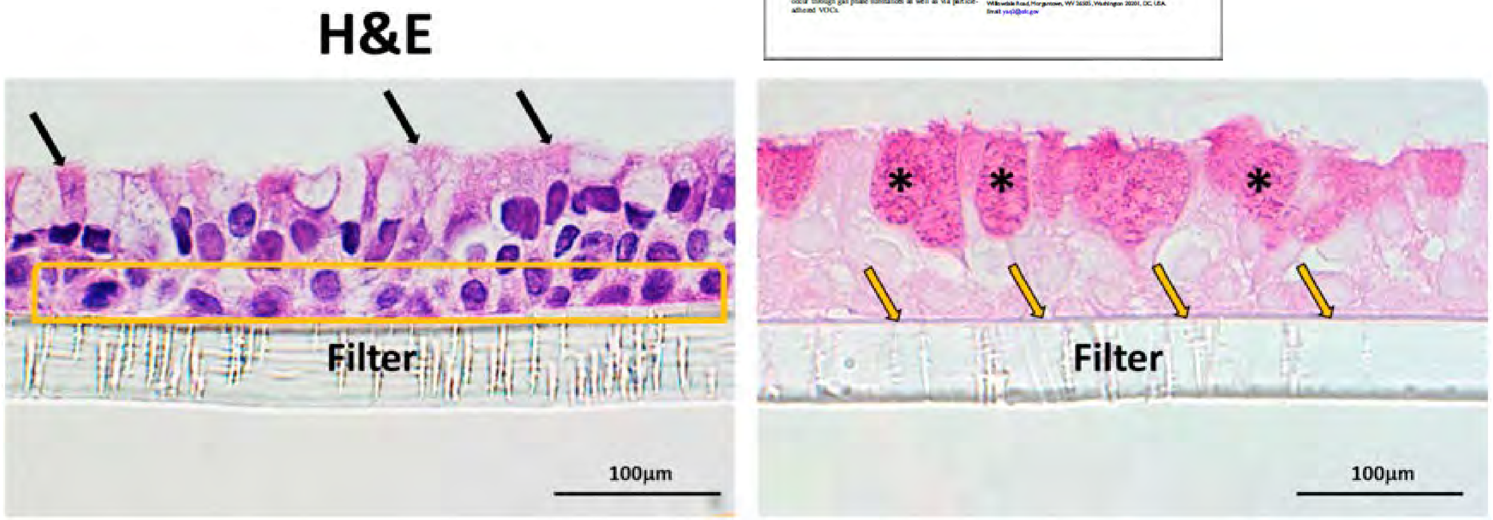
- ABS, PLA and polycarbonate filaments
- CNS, neuroendocrine, pulmonary, and cardiovascular responses
- Engineering controls

Original Article

Evaluation of Pulmonary Effects of 3-D Printer Emissions From Acrylonitrile Butadiene Styrene Using an Air-Liquid Interface Model of Primary Normal Human-Derived Bronchial Epithelial Cells

Mariana T. Farcas[1,2], Walter McKinney[1], Jayme Coyle[1], Marlene Orandle[1], W. Kyle Mandler[1], Aleksandr B. Stefaniak[1,3], Lauren Bowers[1,3], Lori Battelli[1], Diana Richardson[1], Mary A. Hammer[1], Sherri A. Friend[1], Samantha Service[1], Michael Kashon[1], Chaolong Qi[4], Duane R. Hammond[4], Treye A. Thomas[3], Joanna Matheson[5], and Yong Qian[1]

Abstract
This study investigated the inhalation toxicity of the emissions from 3-D printing with acrylonitrile butadiene styrene (ABS) filament using an air-liquid interface (ALI) in vitro model. Primary normal human-derived bronchial epithelial cells (NHBEs) were exposed to ABS filament emissions in an ALI for 4 hours. The mean and mode diameters of ABS emitted particles in the medium were 175 ± 24 and 153 ± 15 nm, respectively.



Continuing Collaboration Work

- EPA:
  - Characterize products and/or waste materials created from the FDM printing process; determine whether the polymeric content present would be classified as microplastics or nanoplastic particles
  - Identify and quantify environmentally persistent free radicals
- Assess hazards such as released microplastic and nanoplastic particulates released during the use of 3D printed toys (NIST).
- NIOSH:
  - Under different exposure conditions, determine the biodistribution of filament emissions and assess microvascular, nervous system, hepatic, and asthmatic responses.
  - Identify effective engineering controls and risk mitigation strategies.

Thank you!

CPSC.gov USCPSC

NNI Public Webinar:
Overview of U.S. Government Activities Addressing Micro- and Nanoplastics Issues
Session 1: Research Agencies (May 22, 2023)
Session 2: Regulatory/Collaborations (June 6, 2023)

Thanks for your attention!

See https://www.nano.gov/PublicWebinars for slide decks
- May 22 posted now; video archive coming
- June 6 (today) will be posted soon

Stay tuned for additional webinars on this topic

Please also contribute to Refreshing the NNI's Environmental, Health, and Safety Research Strategy

See Request for Information at:

https://www.regulations.gov/document/OSTP-POLICY-2023-0005-0001

(deadline extended to June 16)