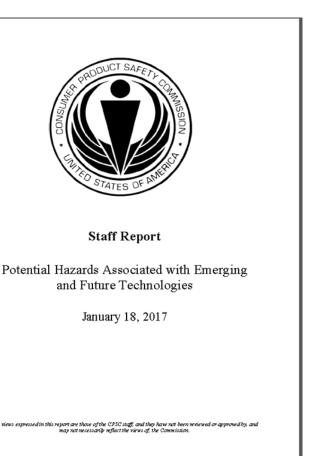


CPSC Report on Emerging Consumer Products

- Released January 2017
- Brief overview of potential emerging consumer products and technologies
- Technological and societal trends likely to influence marketplace for consumers
- Potential consumer safety issues
 - Opportunities for enhancing product safety



Emerging and Future Products

Emerging and future consumer products and technologies identified in this report include:

- 3D Printers and the printed products;
- Internet-home based smart technologies;
- Software as a component part;
- Wearable products and technologies;
- New materials, including nanomaterials;
- Virtual reality (VR) and augmented reality (AR) games;
- Personal transportation products;
- High capacity energy storage and energy generation;
- Robotics, including robotic products to assist older adults; and
- Brain-machine interface/implantable technologies.

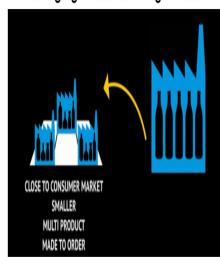
Estimating Exposure and Health Risks From 3D Printing

- Consumer at-home use of 3D printing is increasing rapidly and is expected to reach USD 30 billion by 2022.
 - ☐ Adult hobbyists and home-based manufacturers account for most home use
 - Some 3D printers are being marketed for use by children.
- Broad range of filaments available such as:
 - acrylonitrile butadiene styrene (ABS), high impact polystyrene (HIPS), polylactic acid (PLA), thermoplastic elastomer (PCTPE), transparent polycarbonate, nylon
- Consumers can also make their own filaments using blended materials and home filament extruders.
- Nanomaterials may be used in these filaments
 - CNTs

3D Printing of Products

- Distributed manufacturing
 - Business developed in the home environment to "manufacture" products
 - Larger and more advanced devices
 - Multiple printers and products
- Safety
 - Engineering controls
 - Personal protective equipment (PPE)
 - Storage of materials
 - Accessibility to children and pets

Emerging Manufacturing Model



Distributed Manufacturing

Micro Factories, Home Factories

Made to Order: Just in time, Just to order, Just next door

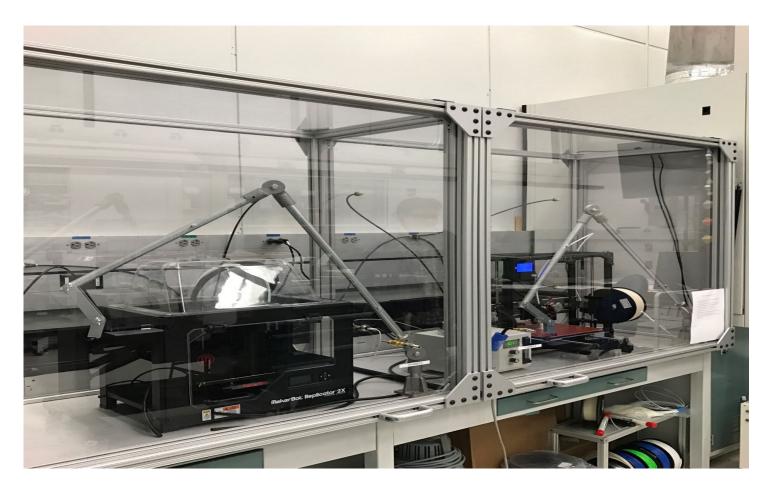
Source: C. Geraci, NIOSH



Health Implications 3D Printing

- What is released during 3D printing?
 - Printing may take several hours
 - High heat ~200 250 C filament extrusion
 - Minimal to no engineering controls
 - Accumulation in the indoor environment
- Advanced versions of 3D printers involve powders
- Exposures across the lifecycle
 - Durability of 3D printed versus traditionally manufactured products

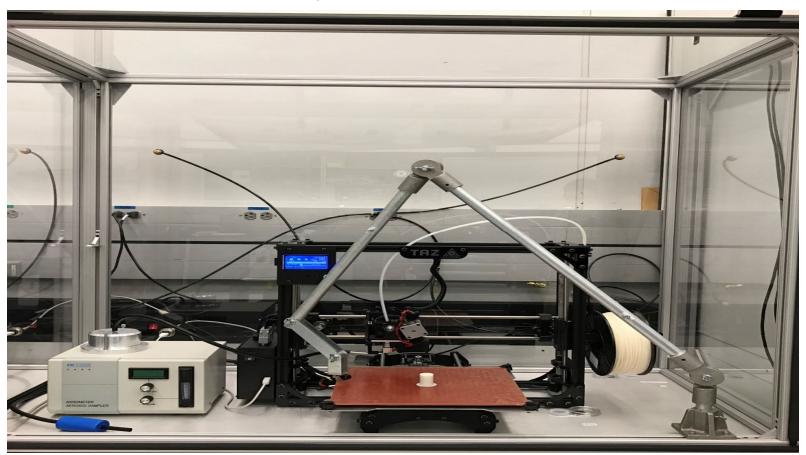
CPSC-NIST Chamber Testing - Nanomaterials Releases During 3D Printing



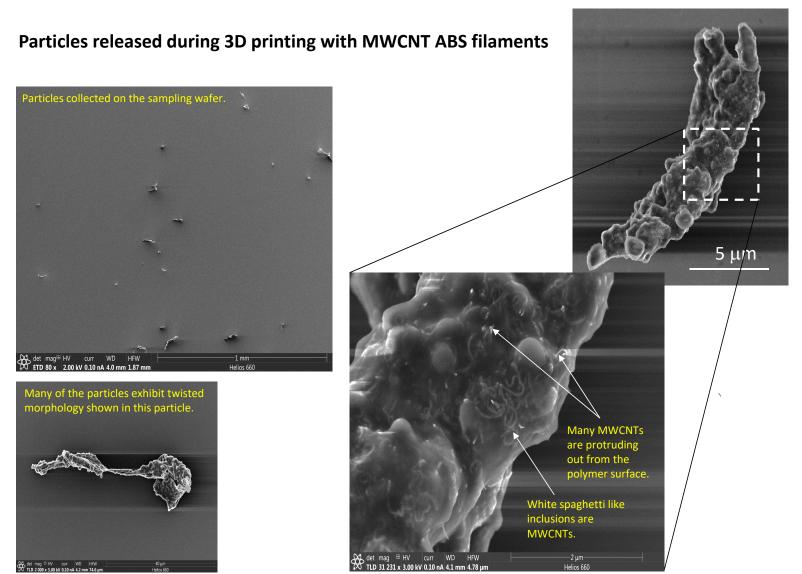
Source: K Scott, NIST

2 separate sampling chambers for 2 different printers

CPSC-NIST Study of 3D Printer Air Emissions



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



Source: Keana Scott et al., NIST