Sources of Metal Contaminants during Fused Filament Fabrication 3-Dimensional Printing

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Abstract

Fused filament fabrication (FFF) 3-dimensional (3-D) printing is a process where a plastic polymer is fed through a heated extruder, melted, and deposited layer-by-layer, onto a build platform. Previous studies have found that some particles emitted during 3-D printing contain metals. Sources of these metals could be from the additives in the filament such as colorants and/or contamination from contact of the polymer with metallic components of filament-making equipment (e.g., extrusion systems) or 3-D printers. Wipe samples of removable metals were collected from surfaces of a filament extrusion system (pellet dryer, filament extruder) and a 3-D printer with twelve different nozzle hot ends (3 replicates of 4 different types [brass, copper, stainless steel, and Ruby]). In total, 50 wipe samples were collected and analyzed for metals using NMAM 7303. Traces of beryllium, a known carcinogen, were seen in each of the 12 hot ends for the 3-D printer. Concentrations of beryllium in all hot ends ranged from 0.3 ng/cm^2 to 47.3 ng/cm^2. High concentrations of iron (31815.1 ng/cm^2) were measured on the metal mixing arm of the pellet dryer component of the filament extrusion system. Metallic components of filament making equipment and 3-D printers could be sources of metals contamination in aerosol released during 3-D printing. Aerosol sampling while using a pure (no additives) filament for printing and pellets for filament production are the next steps in this study.

Biography of Presenter (in 12 Pt Ariel Font)

Lauren N. Bowers is a Biological Science Laboratory Technician with the Respiratory Health Division at NIOSH. She received her Bachelor of Science degree in Chemistry with a Biology minor from West Virginia Wesleyan College in 2015. In 2016, she joined NIOSH where she has assisted in a variety of projects, mainly focused on nanomaterial characterization, as well as aerosol emission characterization of additive manufacturing machines. During her time at NIOSH, she has received two awards for the research she assisted with. She received the Charles C. Shepard Award for Laboratory Science in 2019, and in 2021, she received the Excellence in Laboratory Research from the CDC/ATSDR Honor Awards. She was also interviewed by additivemanufacturing.media on the topic of “Are Emissions from 3D Printing Hazardous to Your Health?”