# Ontology - Driven Nanosafety Assessment: The case of nano - enhanced polymers in 3D printing (FFF)

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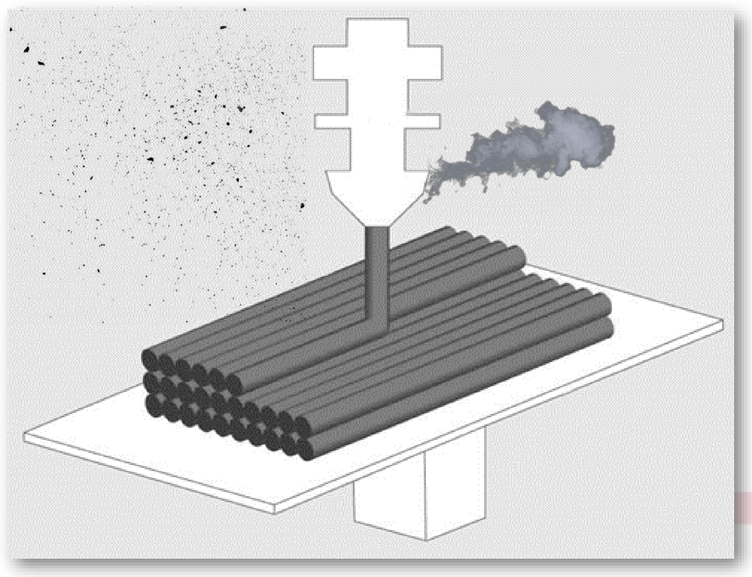
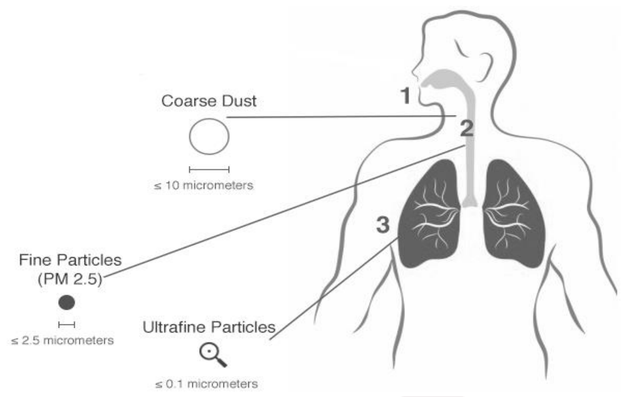
Fused Filament Fabrication (FFF) is an Additive Manufacturing technique consisting of producing objects layer upon layer. In FFF, a solid thermoplastic filament is deposited through a moving nozzle, heated close to the filament melting point. Hazards of FFF mainly regard hazardous emissions but also several minor operation hazards.

*FFF Hazard Identification*



Ultrafine particles (particles smaller than 100nm) are emitted in significant numbers during FFF process. Their increased specific surface area and lung penetration can lead to a multitude of health issues as a result of exposure.




## Emissions Measurements

*We measure the particles emissions of different polymer materials with a series of instruments*

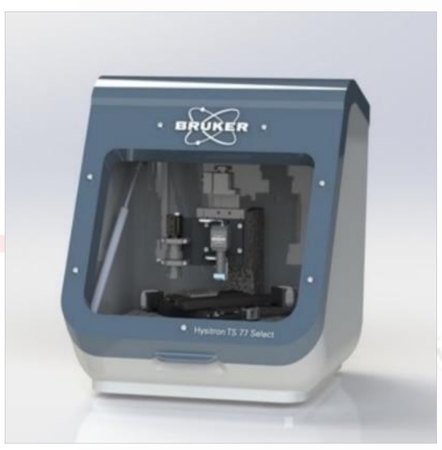
Dylos DC1700
PM 2.5 & PM 10
Particle count measurements

TSI AEROTRAK 9306 Instrument
Measurement of particles
300 nm - 20 μm

TSI CPC3007 Instrument
Measurement of particles
10 nm - 1 μm

## Nanoindentation Data

*Nanoindentation is a characterization technique that measures nanomechanical properties and material surface quality. It is used to assess the quality of the filaments*




## 3D Printing Process Parameters

*We extract the FFF parameter configurations from the open source software of Prusa i3 MK35*

*Prusa i3 MK35*

## Semantic Integration of the tree different Data Sources

Different nanomaterials have different emission profiles. However, the magnitude of the emission isn't only dependent on the materials' structural characteristics, but also heavily depends on the parameters of the 3D printing procedure. In order to study the correlation between the various factors, the data sources are integrated and the data are documented using an application ontology. The generated data set includes measurements of nanomechanical properties and surface quality of the material, extracted G-code files with the 3D printing parameters, as well as different data streams form the emission measurement instruments.

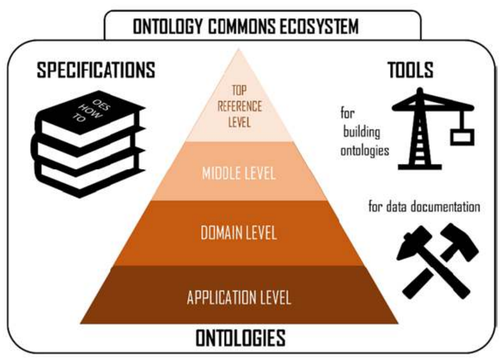
## The top - level Ontologies

There are already existing ontologies for the Nanoindentation, Additive Manufacturing and Nanosafety domains. However, these domain ontologies are formulated based on two different top - level ontologies: The Basic Formal Ontology (BFO) and the European Materials Modelling Ontology (EMMO)

## Reasoning - Knowledge Discovery

The semantic data documentation enabled by the top reference ontology will allow for the execution of automated reasoning. This process will better describe the intrinsic relationships between nanomechanical properties, 3DP process parameters and the resulting magnitude of emissions.

## The top - level Ontology alignment: The Ontocommons project




The ontology - driven nanosafety assessment case study is developed within the Ontocommons project, which will develop a top reference level to align concepts derived from different top - level ontologies.

Moreover, Ontocommons will create an ecosystem that will facilitate ontology development. Learn more about Ontocommons at:

https://ontocommons.eu/

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