POLYFORCE – Polymers with and without reinforcements for part manufacturing through selective laser sintering

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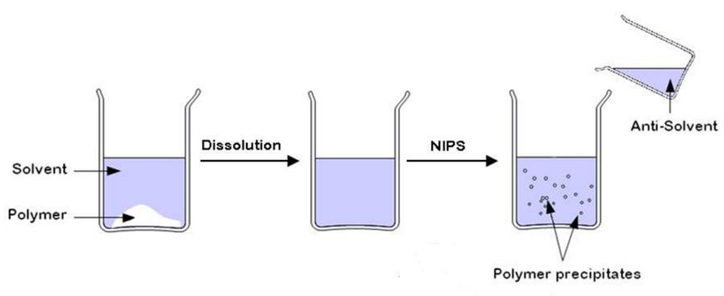
Introduction

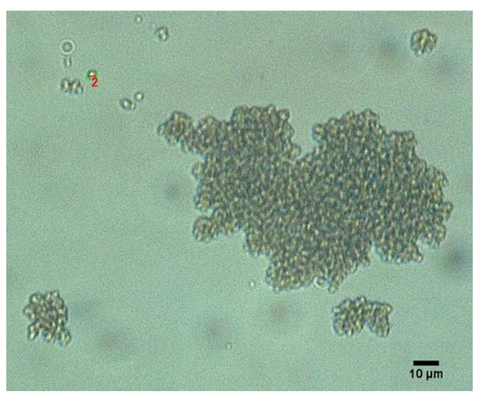
Selective Laser Sintering (SLS) is an additive manufacturing process that forms 3D objects by selectively fusing together successive layers of powdered material. The advantage of such processes is the ability to form parts with significantly greater geometrical complexity than can be done in more traditional processes. Although SLS is mostly known as a rapid prototyping technique it recently expanded its field to the production of actual end-of-use parts. A stumbling block in the progression of this technology is the limited range of materials that can be processed. With the current move towards the end-use products the mechanical properties of the produced parts become increasingly important and other materials need to be developed to broaden the application window. This research focuses on finding a general method to process possible polymers into a suitable form for SLS printing using both mechanical and physico-chemical approaches. It is our goal to produce in this way small spherical particles of about 50-90 µm with a good density. Within the scope of processing techniques extra attention will be given to spray drying and solution precipitation techniques next to conventional ball milling as they are most likely to yield the desired particles.

Processing methods



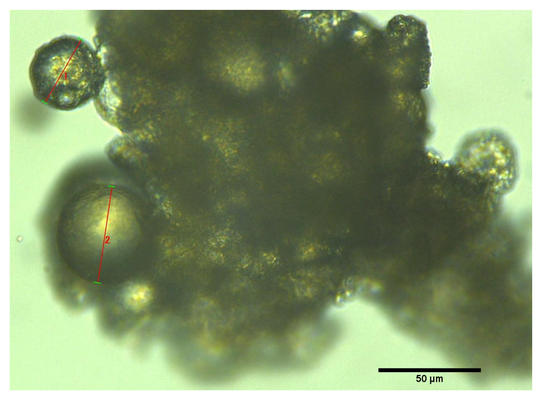
SOLUTION-PRECIPITATION

Optical microscopy

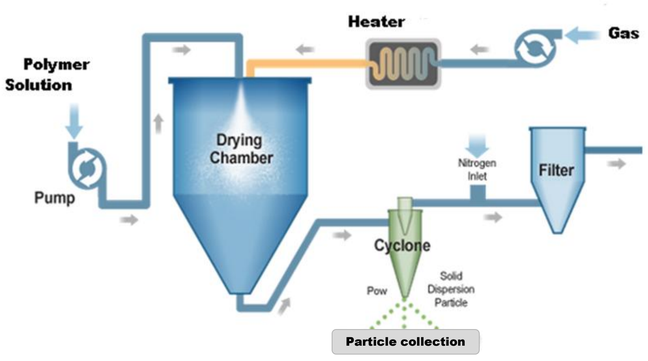


Spherical particles
Agglomeration
Diameter < 10 µm

Stabilization

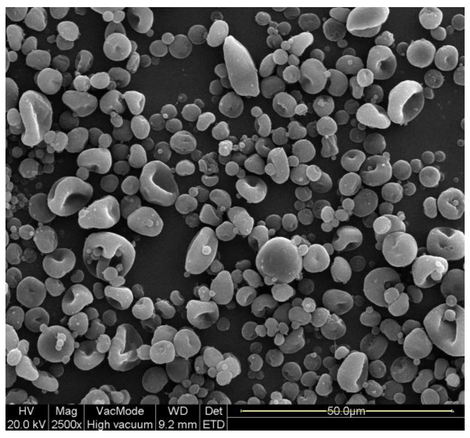


Spherical particles
Agglomeration to spherical clusters
Cluster size < 50 µm



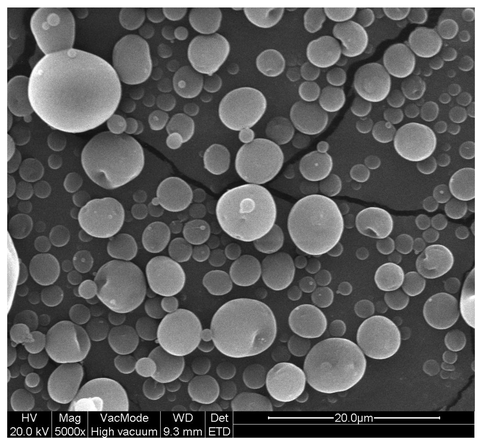
SPRAY DRYING

SEM analysis



Flawed morphology
Diameter < 10 µm

Optimization



Spherical morphology
Diameter < 10 µm

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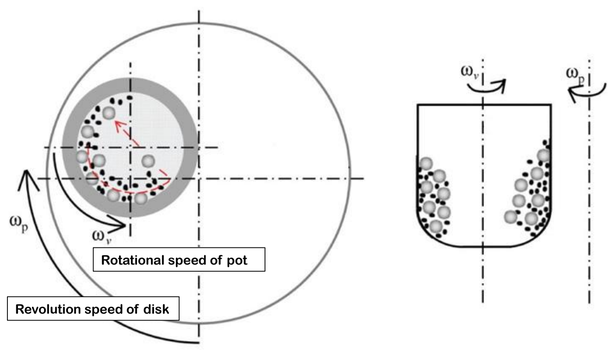
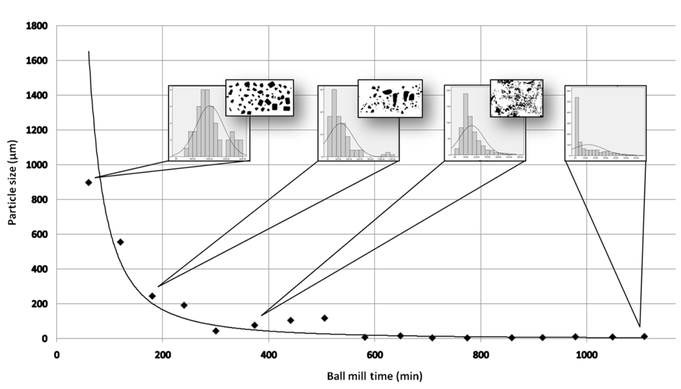
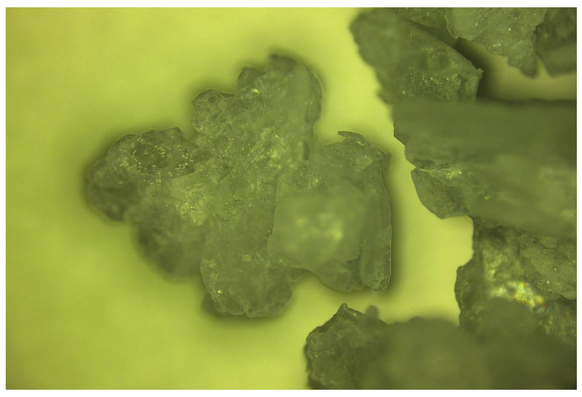


PLANETARY BALL MILL

Optical microscopy



Optimal size achievable



Undesirable morphology

Outlook

The main focus in this research lies on the optimization of the current existing processes to form the desired particles. Particles of desired morphology are already feasible yet size optimization is still ongoing. A theoretical correlation will be made between the mechanical and thermal properties and the used technique.

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