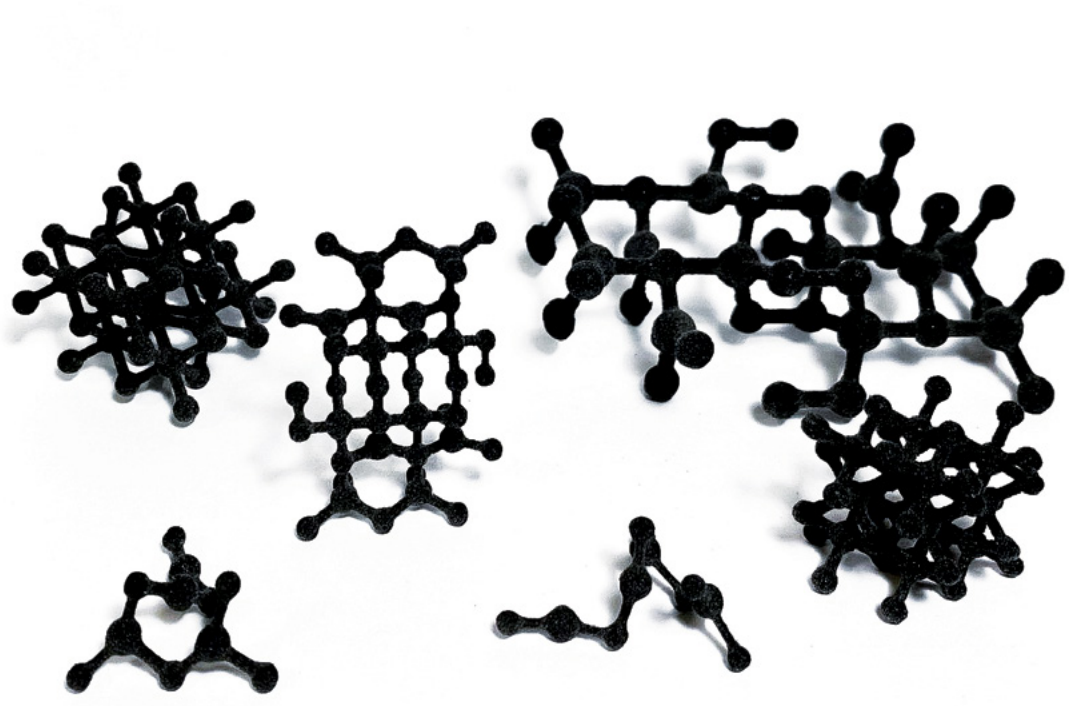
alpha powders

Whitepaper

March, 2025



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page 2: PBF powder thin layer, AlphaPowders

page 3: PBF polymer powder in storage container, AlphaPowders

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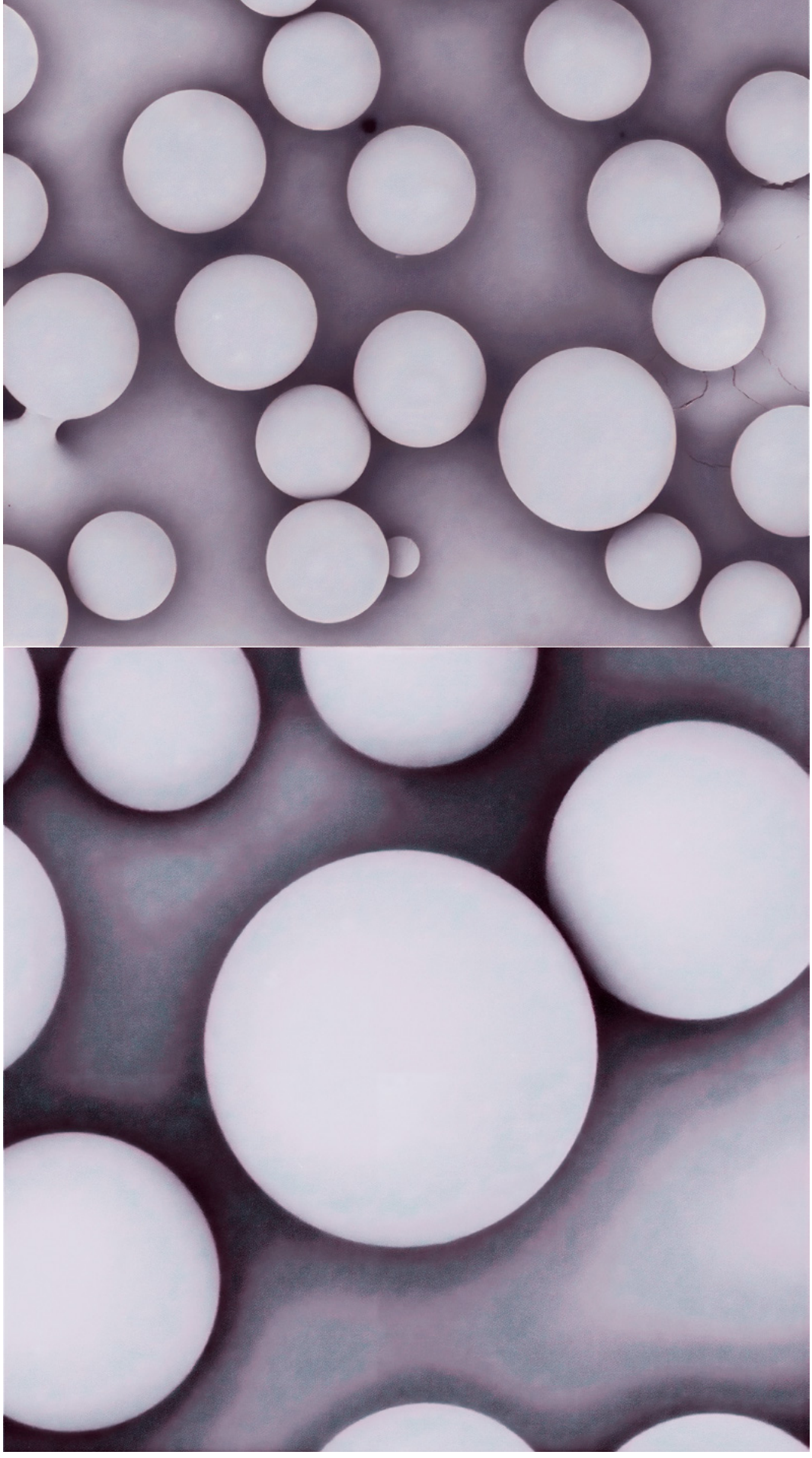


SEM images of a powder spheroidized in AlphaPowders process, AlphaPowders

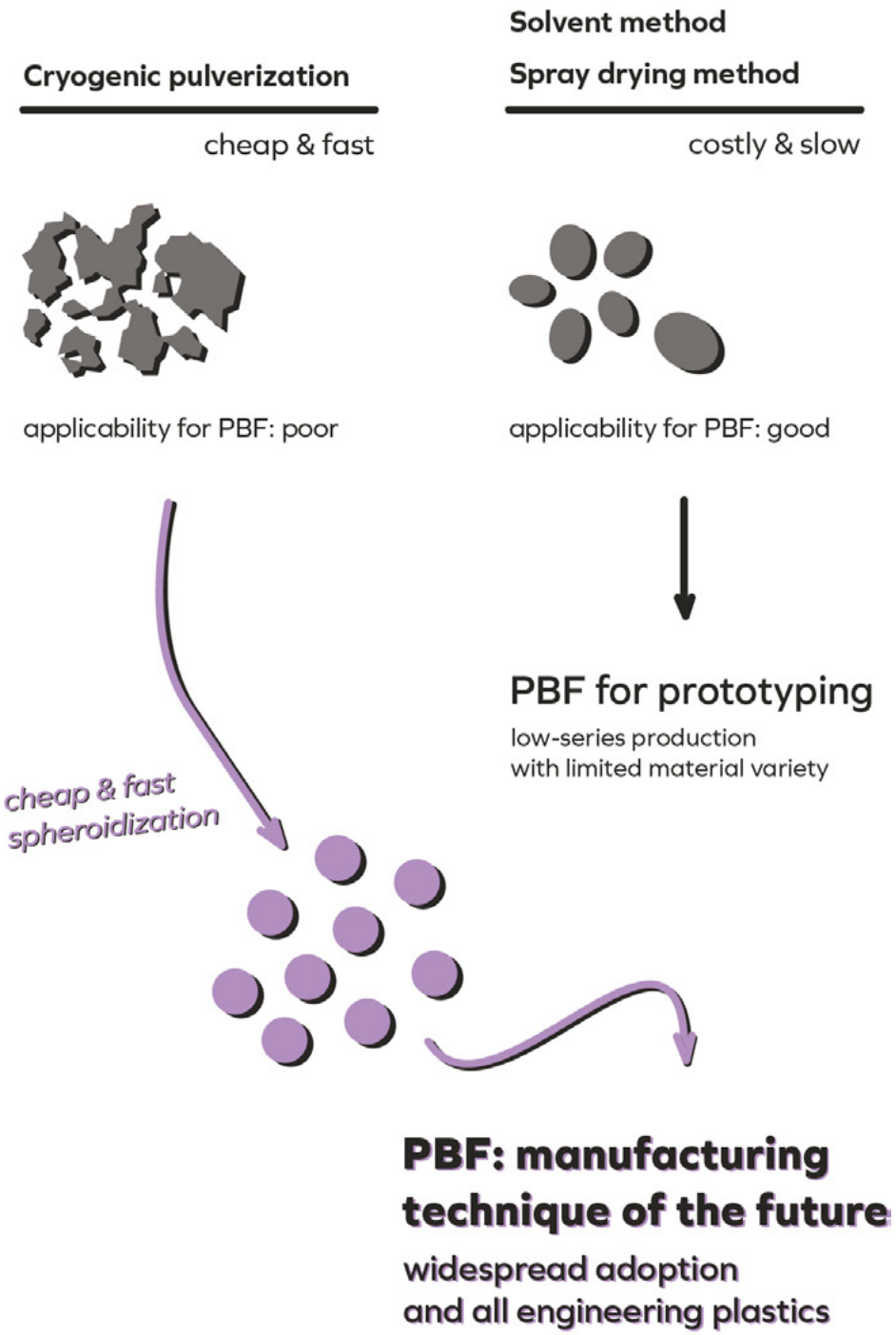
problem definition

At Alpha Powders we believe polymer PBF* deserves widespread adoption in mid--scale manufacturing and will play a key role in the Industry 4.0 of the future. However, that would require the powder to be 3-5x cheaper for the end user than it is now. This calls for a revolution in powder manufacturing technology. The current powder cost is ramped up by efforts to afford powders with excellent flowability characteristics. Cryo-ground polymer particles can be made cheaply, but have rough, irregular edges and are not suitable for PBF.
On the other hand, perfectly spherical polymer particles can be made during polymer synthesis, or by wet post-processing, but these technologies cannot bring the cost down sufficiently.

The widespread adoption of PBF additive manufacturing requires a revolution in the way spherical powders are made.

The widespread adoption of PBF will have to be accompanied by a significant broadening of the portfolio of available materials. Currently, 80% of PBF parts are printed out of polyamide. We see an immense potential here, with materials like polyolefins, elastomers, composites and functional powders increasing their market shares considerably.

*PBF - Powder Bed Fusion



Spheroidization — a crucial link in novel powder manufacturing chain, AlphaPowders

the solution

In order to make 3D printed parts of sufficient toughness and the highest surface quality, the particle size and shape needs to be precisely controlled. Perfectly spherical particles afford excellent flowability, low porosity and high mechanical strength of the parts. In this context, we see a demand for a cheap, easy to implement and industrially viable spheroidization technology, that could bring any arbitrary polymer powder to a purely spherical shape. This way, the benefit of low-cost cryogenic grinding technologies could be utilized, while still obtaining a product of excellent parameters.

We believe that a new, dedicated technology is the only way to go for powder manufacturing. The unique requirements of shape and thermal properties imposed on PBF powders make the classic production approach too expensive to reach most of the SAM* market.

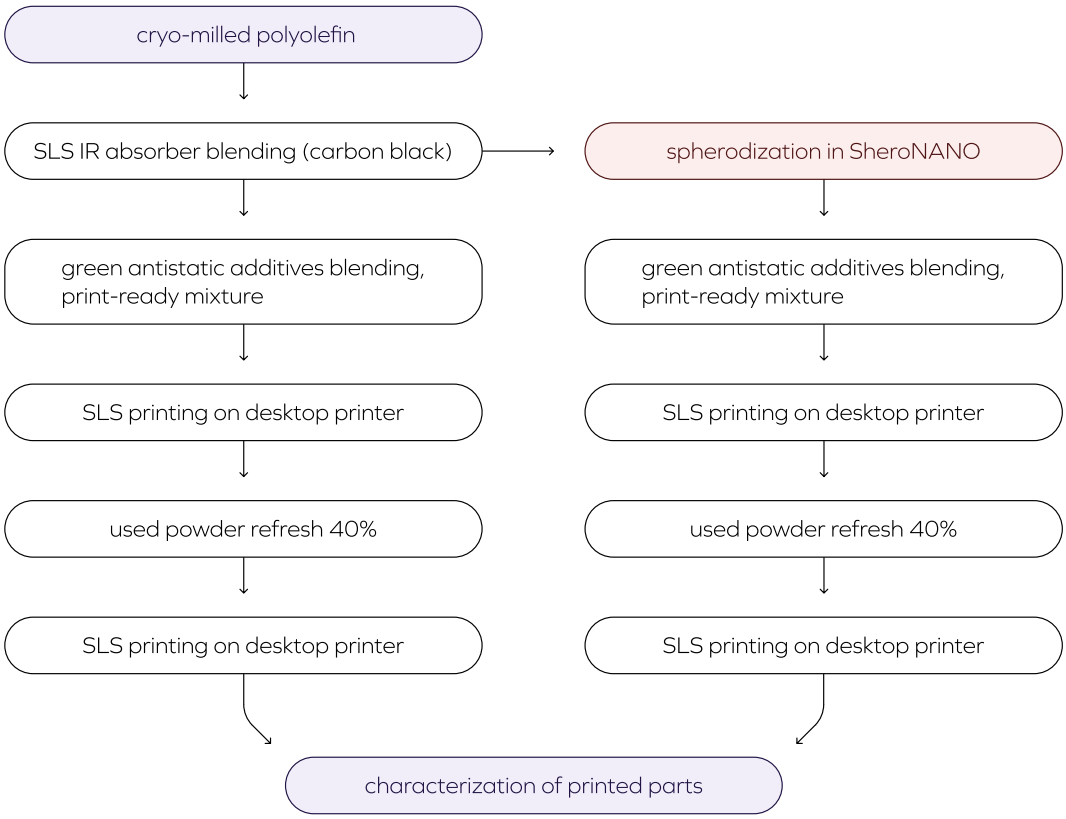
*SAM - servicable available market

Attempts at processes which could cheaply transform large amounts of poor quality powder so far did not prove industrially viable. They often have low product efficiency, cannot work with a wide range of thermoplastic materials or offer sub-par throughputs.

FUTURE IMPACT

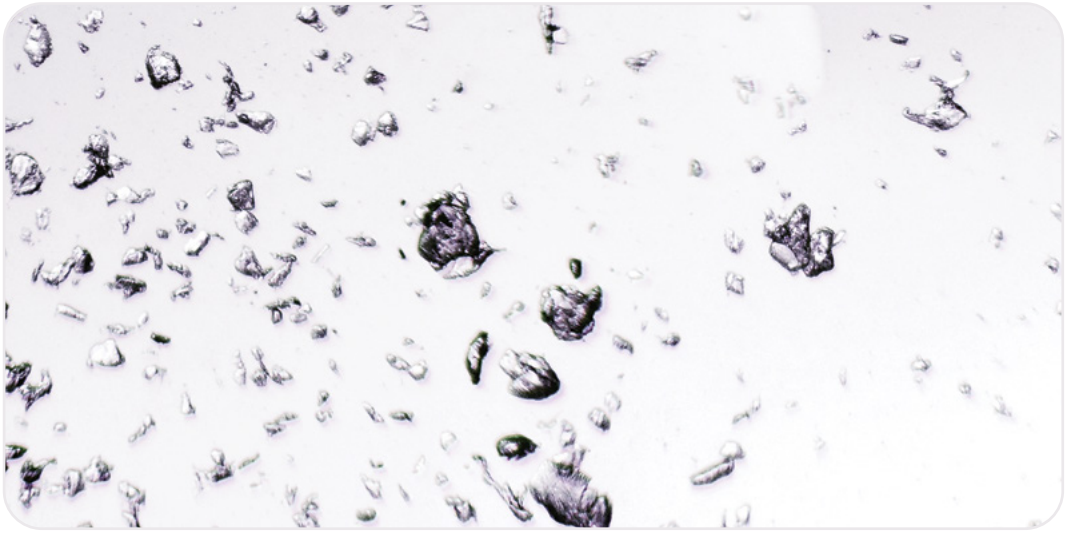
In our vision, spheroidization is the missing piece of the puzzle that enables a completely new manufacturing chain for polymer powders. We are working on a model pilot-scale plant demonstrator, where optimized cryo-milling technology and continuous spheroidization SpheroPRO devices work together to yield 10 T/year of perfectly spherical powder, made of any thermoplastic. **With this, we aim to open a new chapter in polymer powder-based manufacturing**

Depowdering of parts printed out of spherical polyolefin powder, Alpha Powders

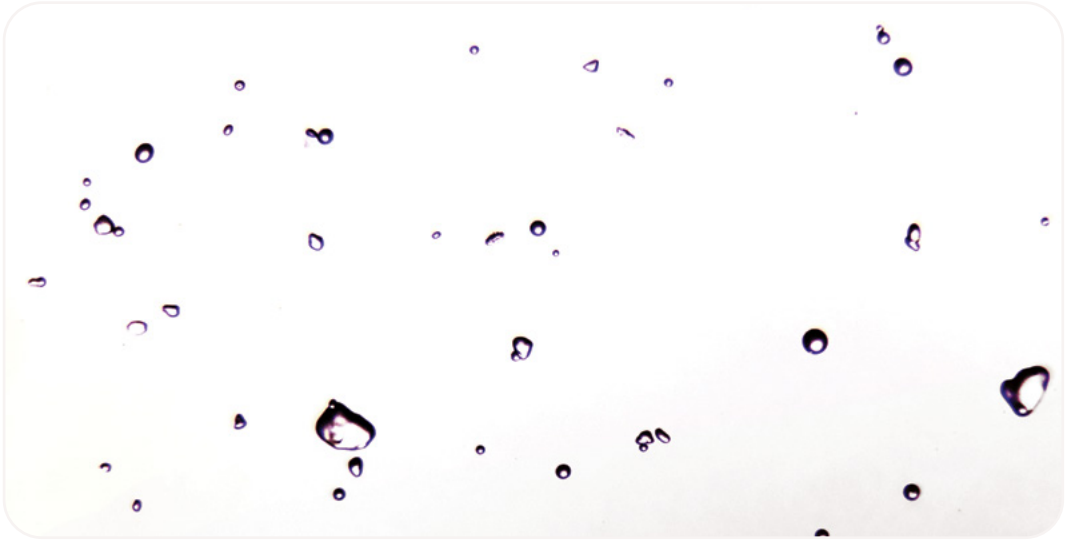


proof of value

This technical insight presents the bulk behaviour and SLS 3D printing of polyolefin powder spheroidized in SpheroNANO system. Cryo-milled PP material was used as input to the spheroidization process, as well as to formulate a reference print-ready powder for comparison.
The spherical powder displayed much increased bulk density, displaying batter packing properties (Fig 2), and increased flowability (Fig 3). Increased density resulted in decreased porosity of the parts (Fig 4, Fig 5), which in turn made the parts stronger (Fig 6). The better packing of the spheres led to reduced dimensional inaccuracies of the parts due to densification upon melting, evident already for samples as thin as 3 mm (Fig 7A). The parts exhibit an improved surface smoothness and appearance (Fig 7B).



Cryo-milled reference, Alpha Powders



Processed in SpherNANO, Alpha Powders

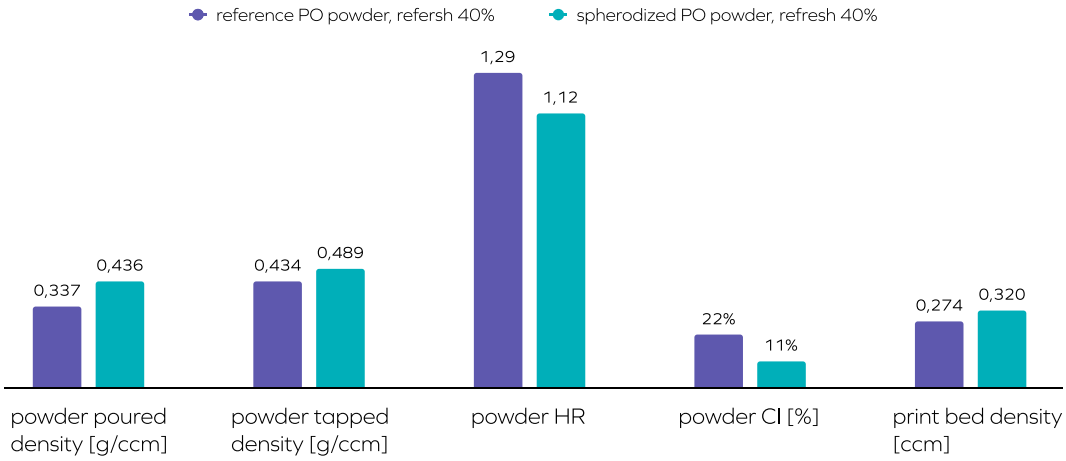


Fig 2 – impact of spheroidization on the packing behaviour of polyolefin powder

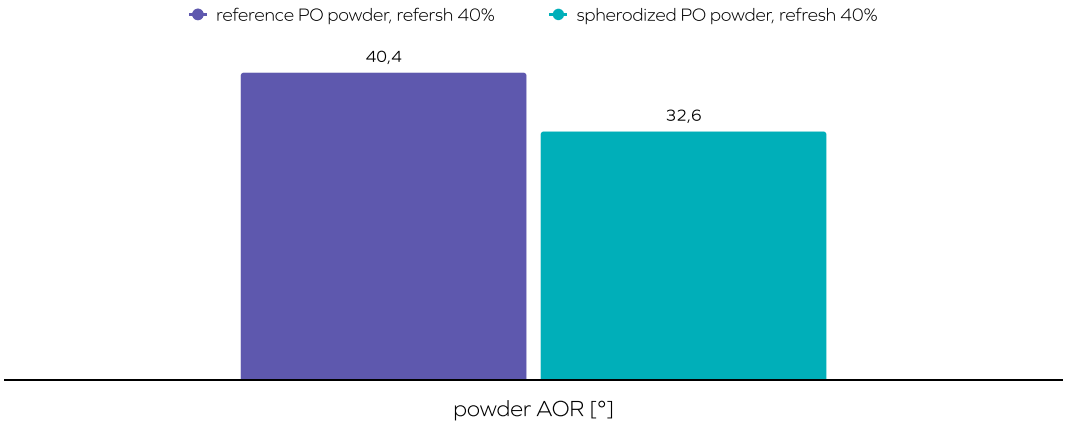


Fig 3 – impact of spheroidization on the flow behaviour of polyolefin powder

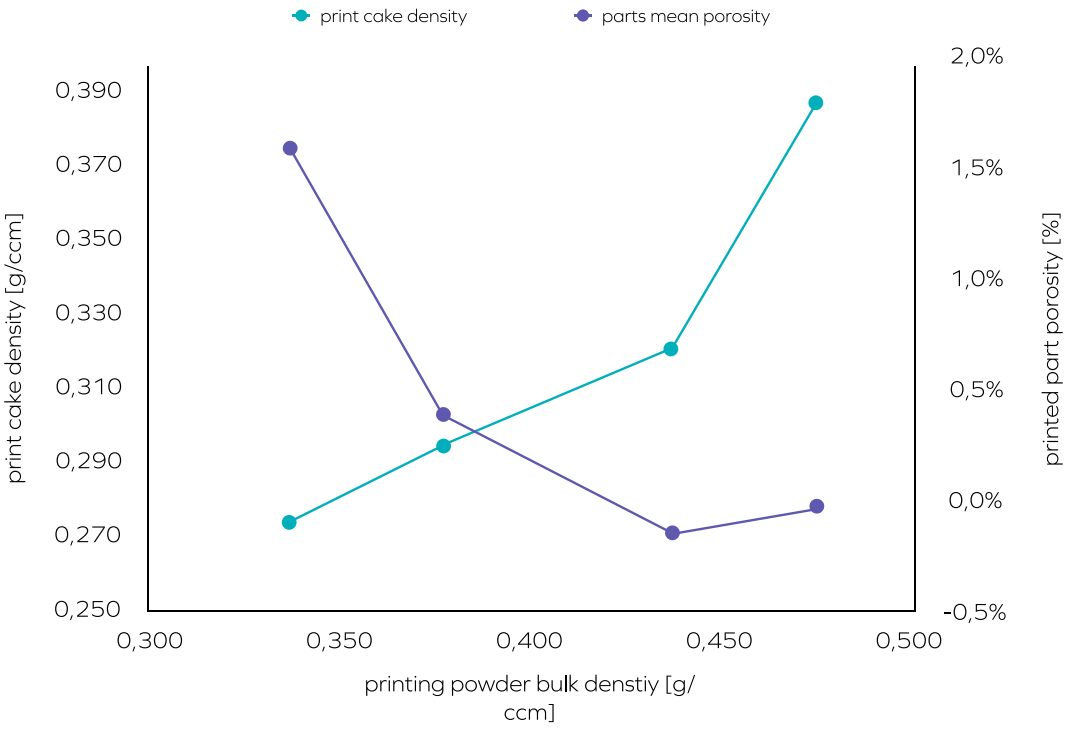


Fig 4 - influence of the powder bulk density on density of the parts

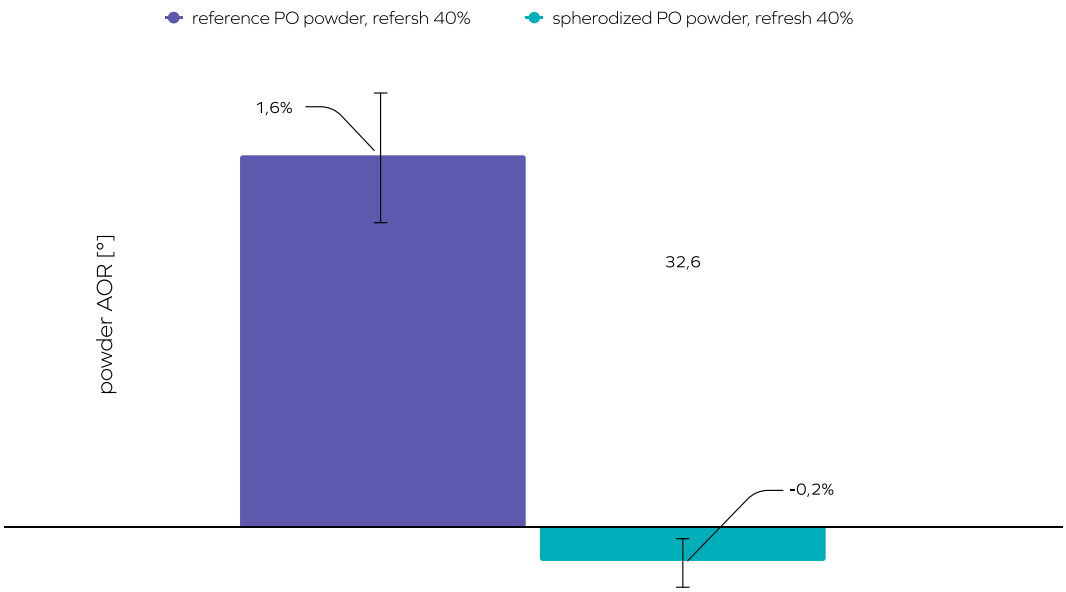


Fig 5 – impact of spheroidization on printed part density

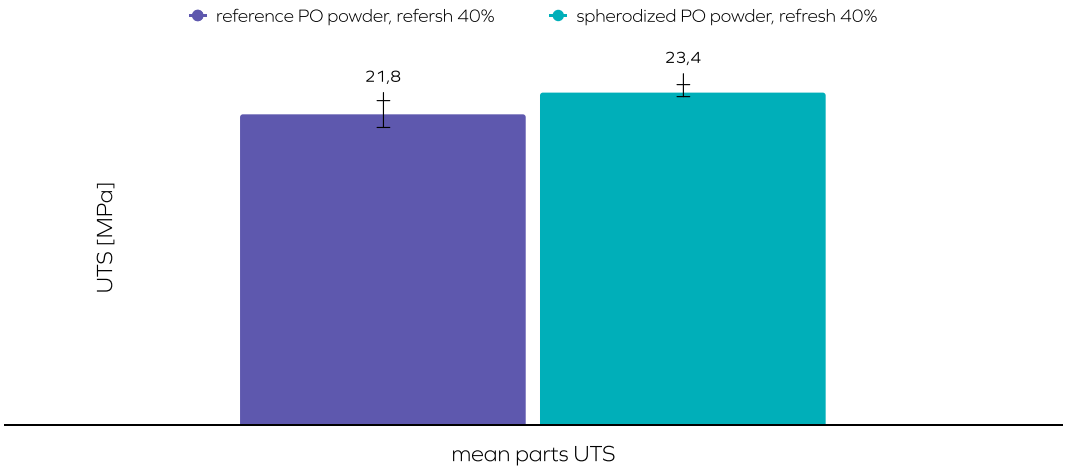


Fig 6 – Impact of spheroidization on the ultimate tensile strength of the printed parts

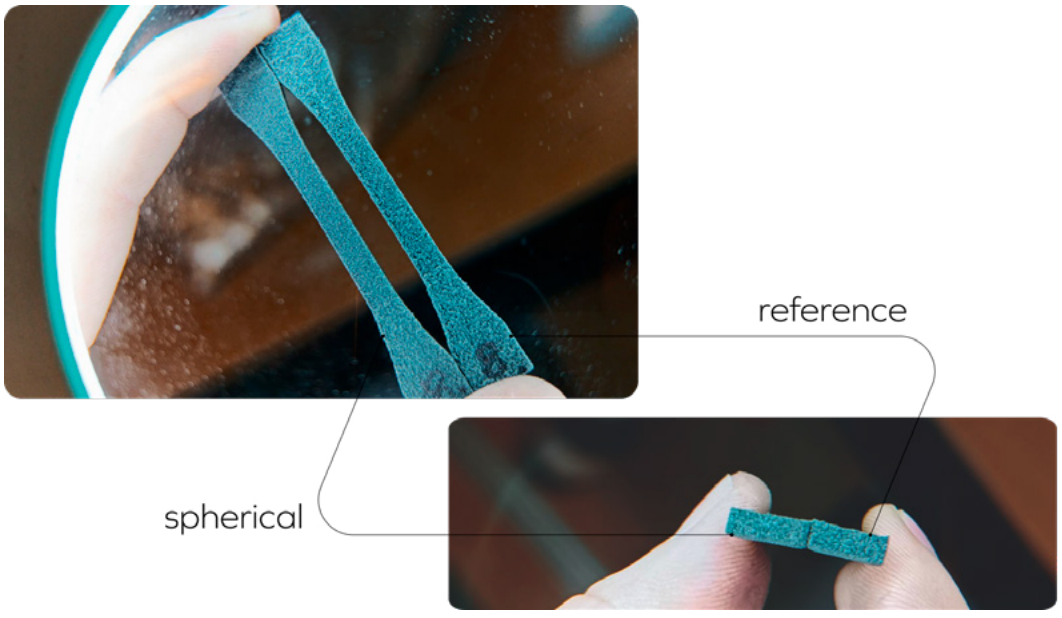


Fig 7 – Impact of spheroidization on the dimensional stability and surface roughness of the polyolefin parts

SpheroNANO™ device, Alpha Powders

- **meant for R&D labs involved in polymer PBF industrial research**
- **development of new materials**
- **validation of the spheroidization process for arbitrary feed materials**
- **development of new industrial processes and products**
- **functional materials research by embedding additives into the powder surface**

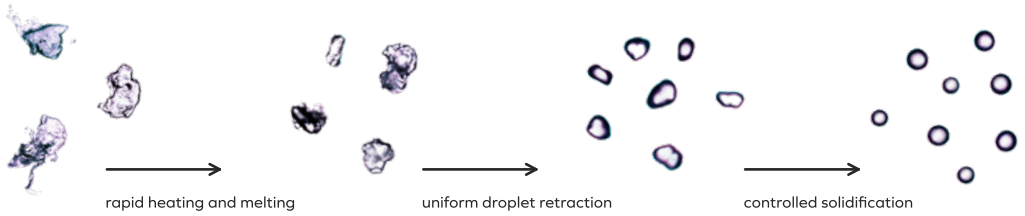
By implementing a scalable version of our patented spheroidization technology with our SPHERO line of devices, our goal is to cover the needs of all our customers, with throughputs ranging from 100 g/h to 50 kg/h and beyond.

our technology

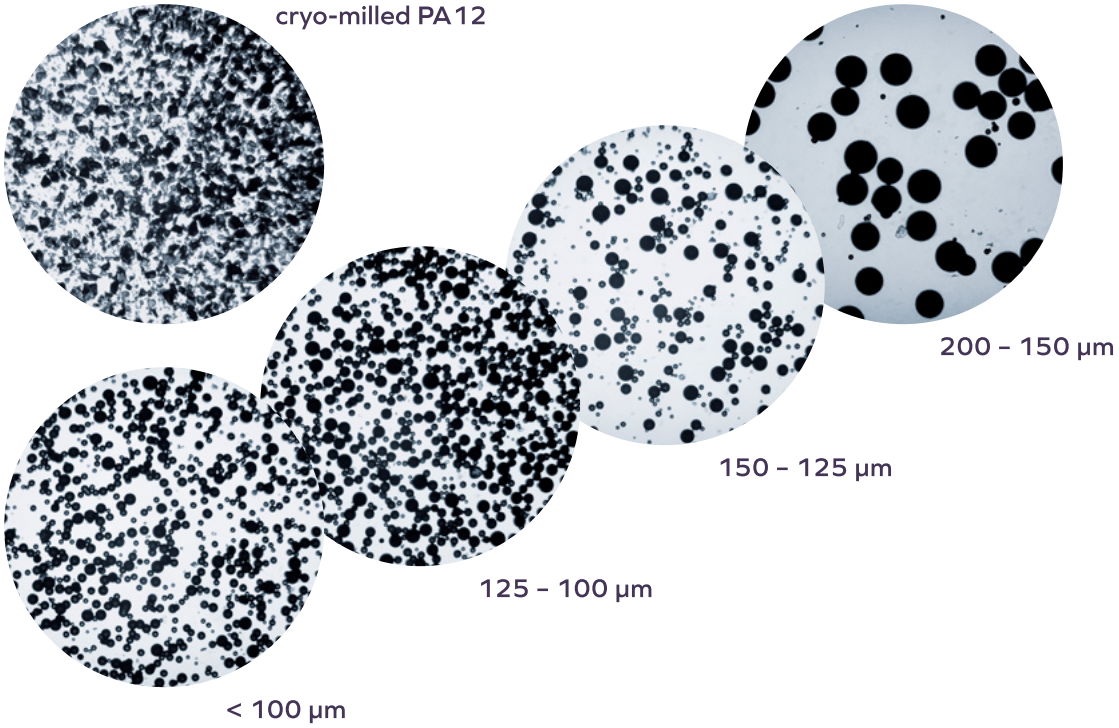
At Alpha Powders we have developed a spheroidization process, which offers a groundbreaking approach to PBF powder manufacturing, allowing the production of top-quality powders with a competitive edge. Our method is dry, cost and time efficient, applicable for every thermoplastic material and easily scalable to every level of production, which makes it unique on the global scale. With it, we can transform low-quality and high-availability products from cryogenic grinding, including highly non-spherical powders, e.g. flakes, at a cost of approximately 2-3 EUR/kg. We imagine a new manufacturing process for PBF powders built around our technology, where cheap feed material can be transformed in one step into powders of excellent quality, drastically bringing down the cost for the final user and contributing to a more widespread adoption of PBF. Our method does not use any solvents or other chemicals. The process is completely dry and continuous. The device is scalable, while maintaining a reasonable size.

We are adapting the spheroidization technology to work even with scrap polymer dust, for example from filtration systems. Such material is considered useless waste but our solution can adapt it, valorise it and create products of sufficient sphericity for PBF manufacturing.

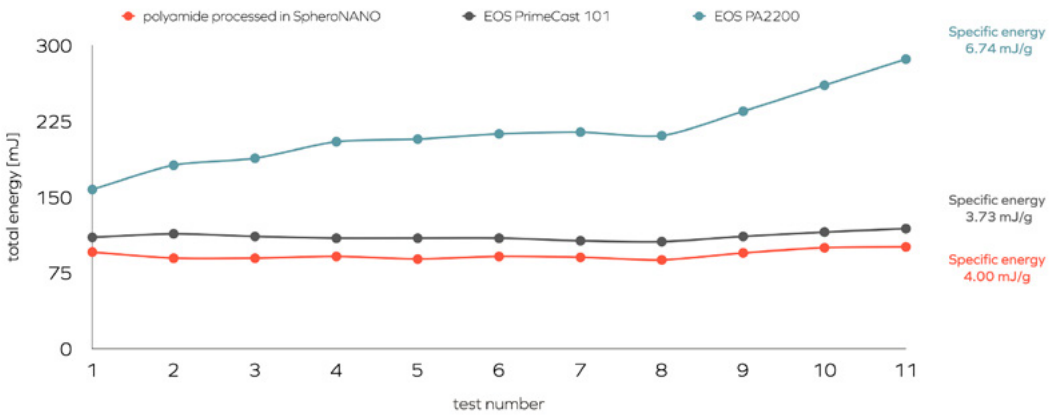
On top of that, it is possible to add additives to the powder, which will be permanently bound to the surface of the powder during the spheroidization process. It allows to obtain parts printed from functional materials, bearing for example magnetic, electric and virucidal properties.



Spheroidization machanism, AlphaPowders



Spheroidization can be tuned to work on every size fraction. Visible light microscope images, AlphaPowders



Cryo-milled and spheroidized PA12 has excellent flow properties. FT4 measurements courtesy of Wrocław University of Science and Technology, AlphaPowders

The sphericity of polymer powders has a positive effect on their flowability, which is a key parameter affecting the quality of PBF printed parts. If the PBF is to compete against injection molding method and become a major element of Industry 4.0 revolution, the powder must become cheaper and more available. Our technology can make it happen. We want to license our solution to custromers using flexible schemes. The base hardware platform will be designed to work with most common materials. The user can expand on it, through high-temperature performance materials package as an extra paid option. Thanks to scalability, our solution will be offered as small R&D devices, as well as full scale production facilities. The big powder manufacturers, chemical corporations and PBF printers manufacturers will benefit from using our spheroidizator. **The powder market itself is estimated to be worth 1.3 bilion USD per year, with the growth of 19%. It is ready and waiting for the solution we have — right now.**

Hardware platform processing low-quality powder, with m. p. up to 240°C & customer support

spheroNANO™ — 0.1kg/h lab scale

spheroPRO™ — 5kg/h pilot scale

extra paid options

- HT package supporting materials melting above 240°C & customer support
- APPAS* system for rapid powder analysis
- Open-system software for fine-tuning of sphercity factor

*APPAS - AlphaPowders Particle Analysis System

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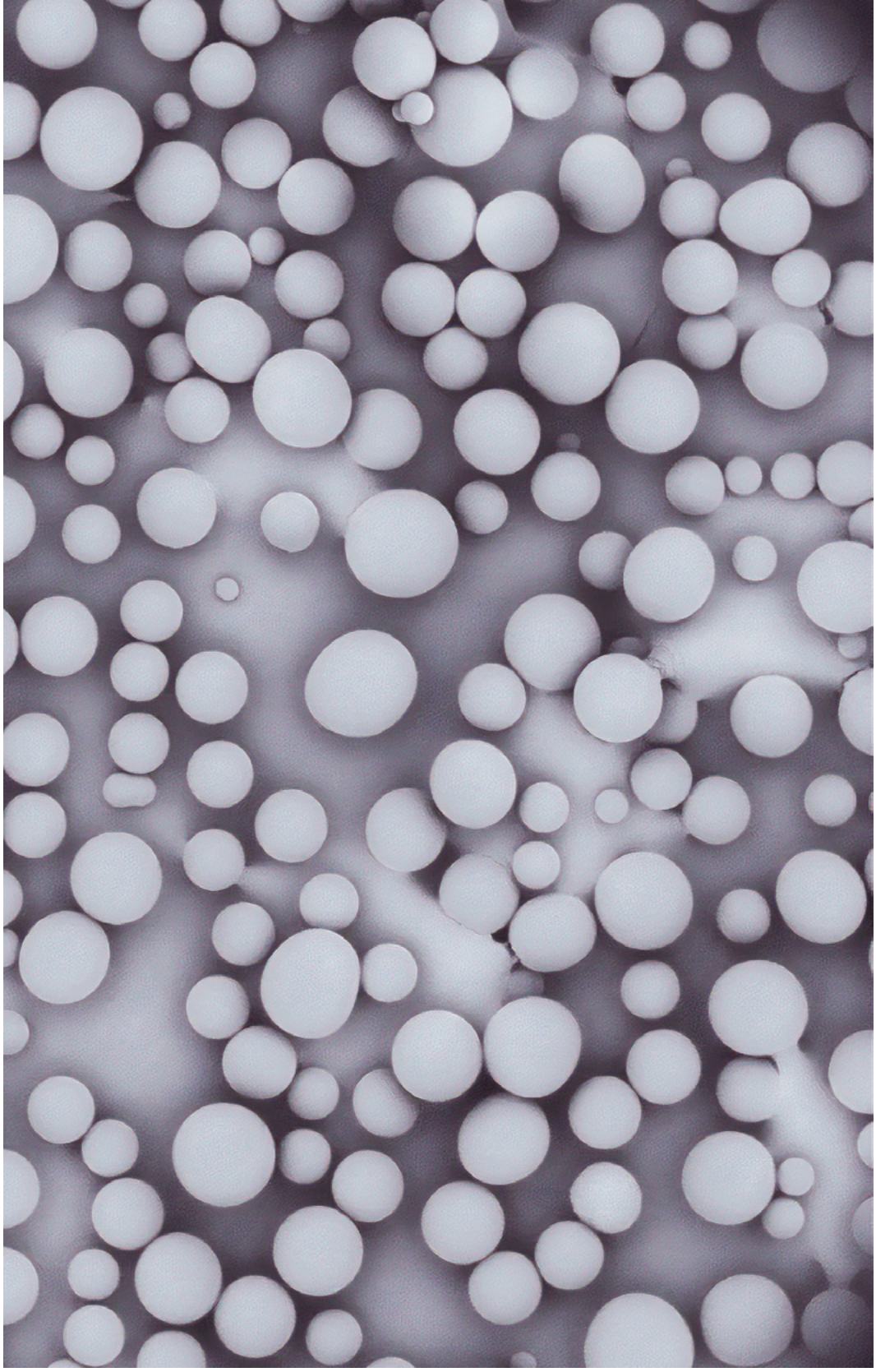

SEM image of a powder spheroidized in AlphaPowders process, AlphaPowders

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