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Processing and characterization of syndiotactic polystyrene into a free flowing powder

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INTRODUCTION

In order to broaden the application window of the Additive Manufacturing technique called Selective Laser Sintering new materials have to be provided that fulfill the necessary requirements as feed material. The powders have to be of spherical morphology with a diameter within the range of 45-90µm. In this research syndiotactic polystyrene (sPS) has been chosen as testing material. Both mechanically (rotor mil) as physicochemically (spray dryer) the sPS pellets are processed into powder form and characterized.

MECHANICAL

Rotor Milling

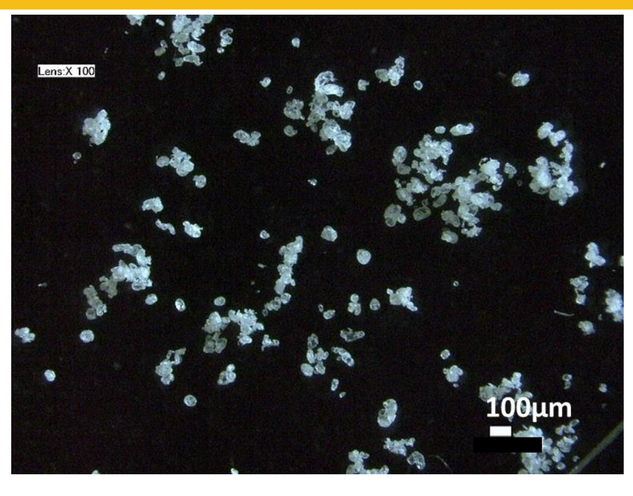
Pulverisation using a three step refinement process with communition of pellets to 500, 120 and 80µm sequentially and sieving at 80µm.
Milling conditions: 16000 RPM at ambient temperature

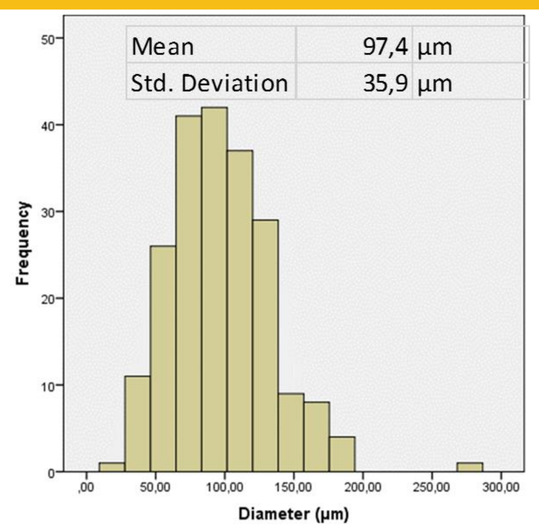
PHYSICOCHEMICAL

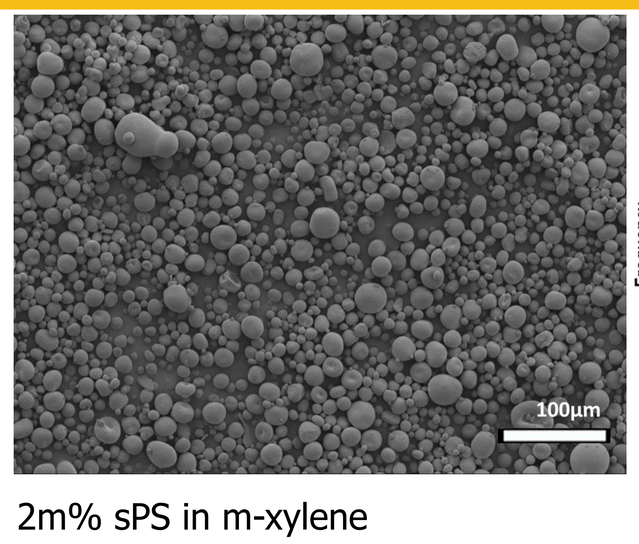
Spray Drying

Dissolution of sPS pellets in m-xylene by reflux at 140°C.
Spray conditions: T_{inlet}: 180°C T_{opl}: 130°C Feed rate: 21,4 mL/min
Using a vibrating orifice nozzle at 2,9 W

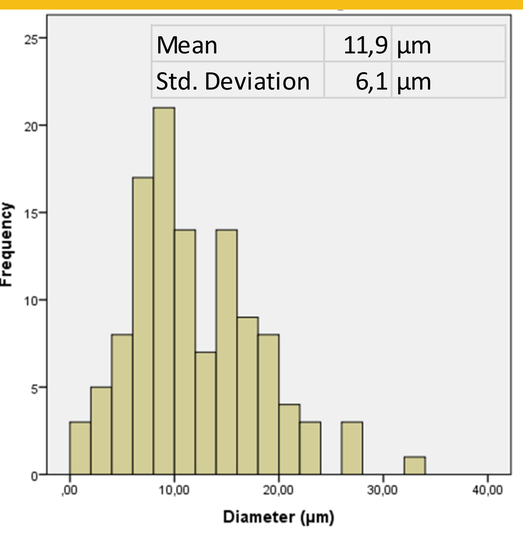
MORPHOLOGY



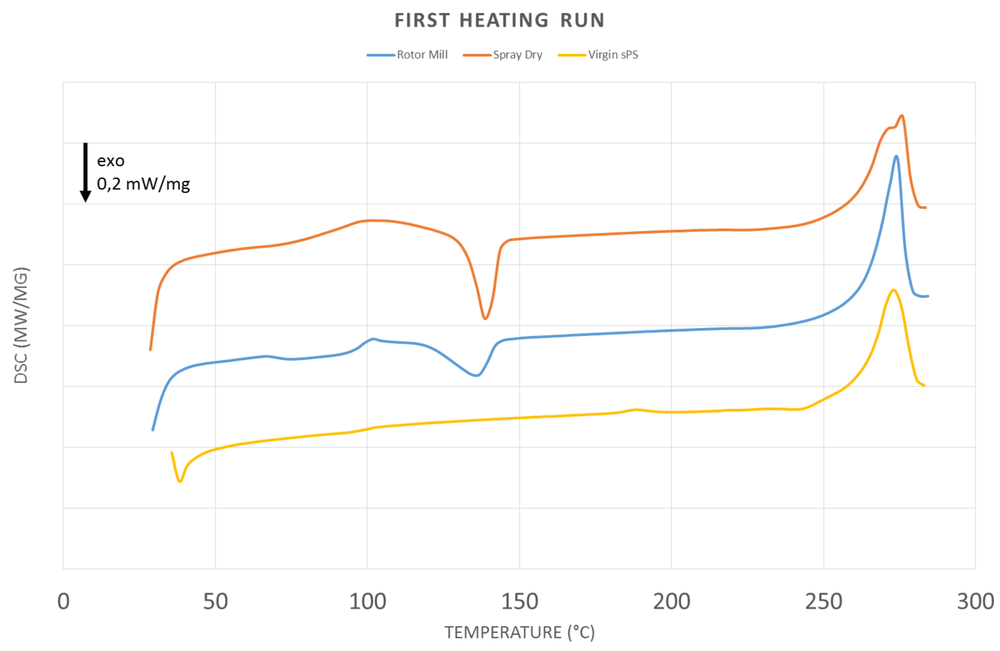




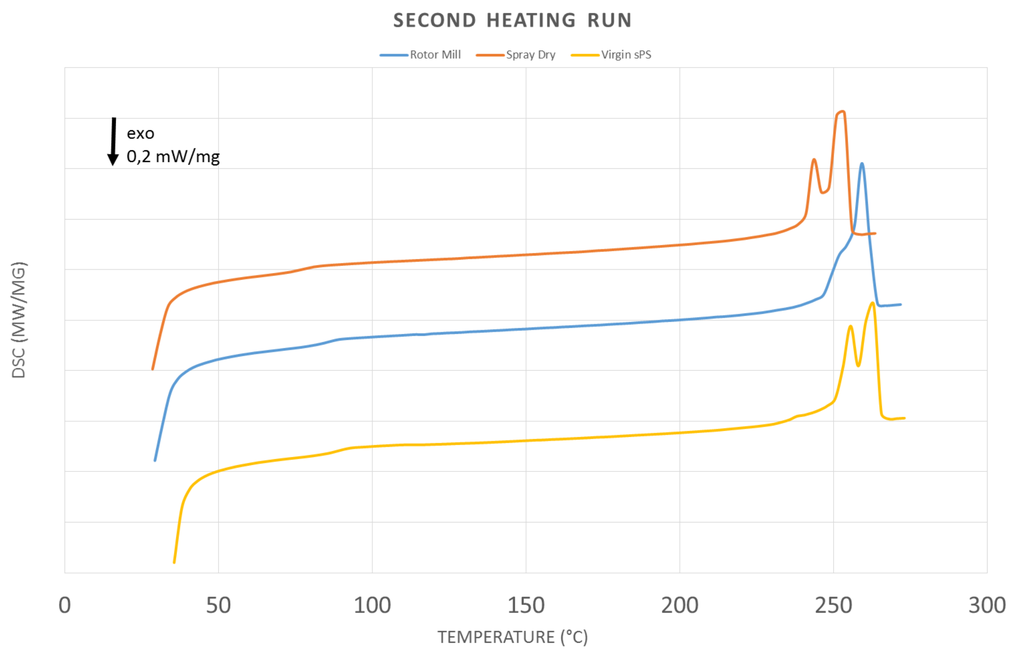
2m% sPS in m-xylene



DSC



- Cold crystallization
- Tg ~ 98°C
- Polymorph melt peak



- α-recrystallization
- % crystallinity: V: 53,8%
  RM: 48,2%
  SD: 47,6%

CONCLUSION

Both methods yield spherical particles albeit spray drying –due to its low m% that can be dissolved- exhibits a lower yield. Of both methods rotor milling gives particles in close agreement to the ideal distribution of powder size while further optimization regarding particle size is advised for spray drying. Both methods impart amorphization on the polymer resulting in cold crystallization during heating. Crystallinity of sPS was reduced to 48,2% and 47,6% for rotor milling and spray drying respectively. It can be suggested that this is caused by degradation due to the processing method. Especially in case of rotor milling as the dual melting peak of the pure α-crystals is strongly reduced.

PolyForce Project
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