



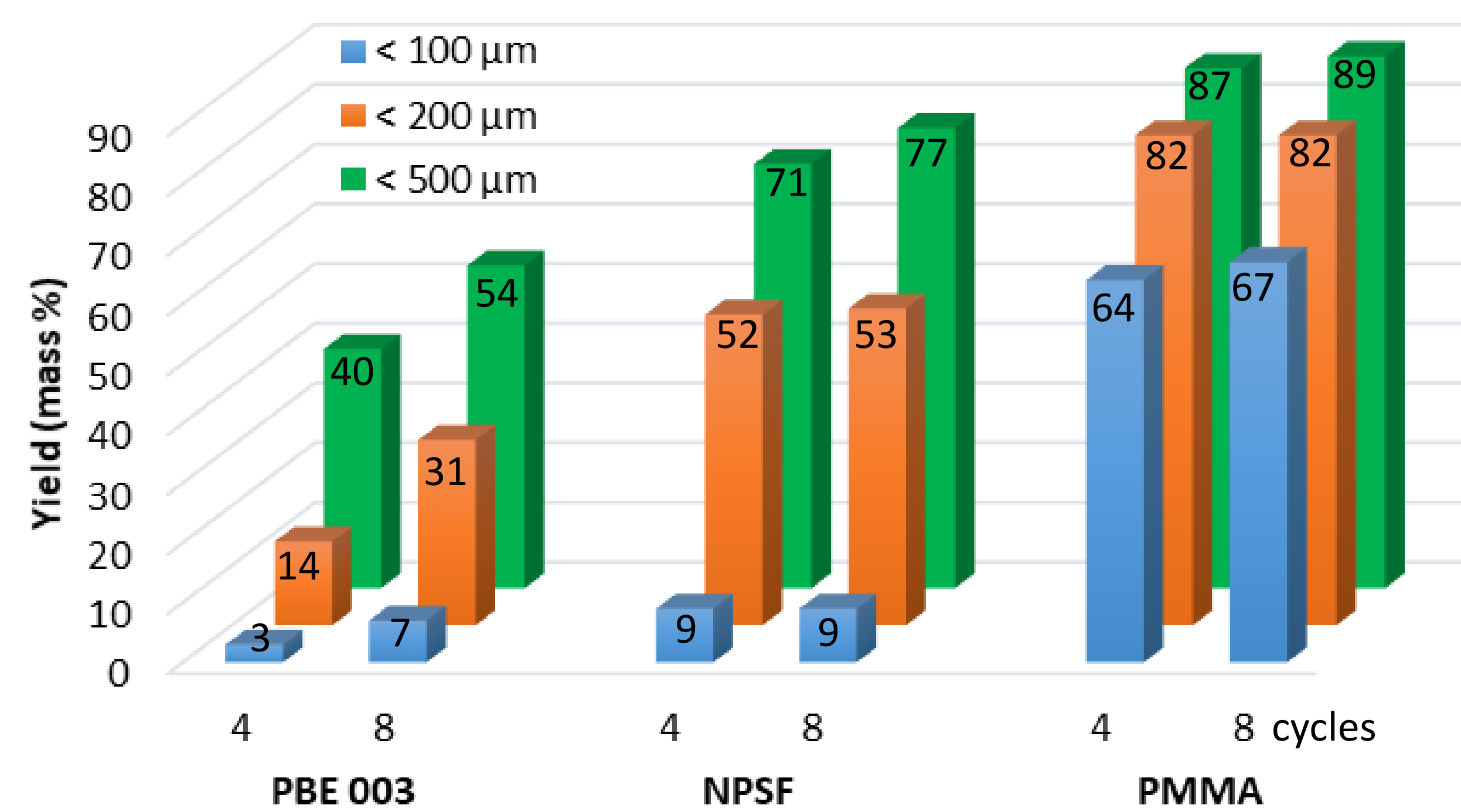
# Preparation of Microparticles for Microplastic Research by Cryo-Milling

## Introduction

Microplastic research is fundamental for assessing the potential impacts of microplastic particles on environment and human health. However, laboratory and field experiments on microplastics demand smallest particles, which are often hard to produce. Especially the fragmentation of bio-based plastics is challenging, as most plastic brands are tough and resilient against mechanical impact. Here we present a method to grind different plastics in a cryogenic mill and describe the resulting products as well as advantages and disadvantages of the method.

## Materials & Methods

- 1g of plastic pellets were cooled and mechanically ground in a cryogenic mill (6775 Freezer/Mill, Spex SamplePrep).
- Particles were sieved for fractions < 500  $\mu\text{m}$ , < 200  $\mu\text{m}$ , and < 100  $\mu\text{m}$  and inspected by scanning electron microscopy.



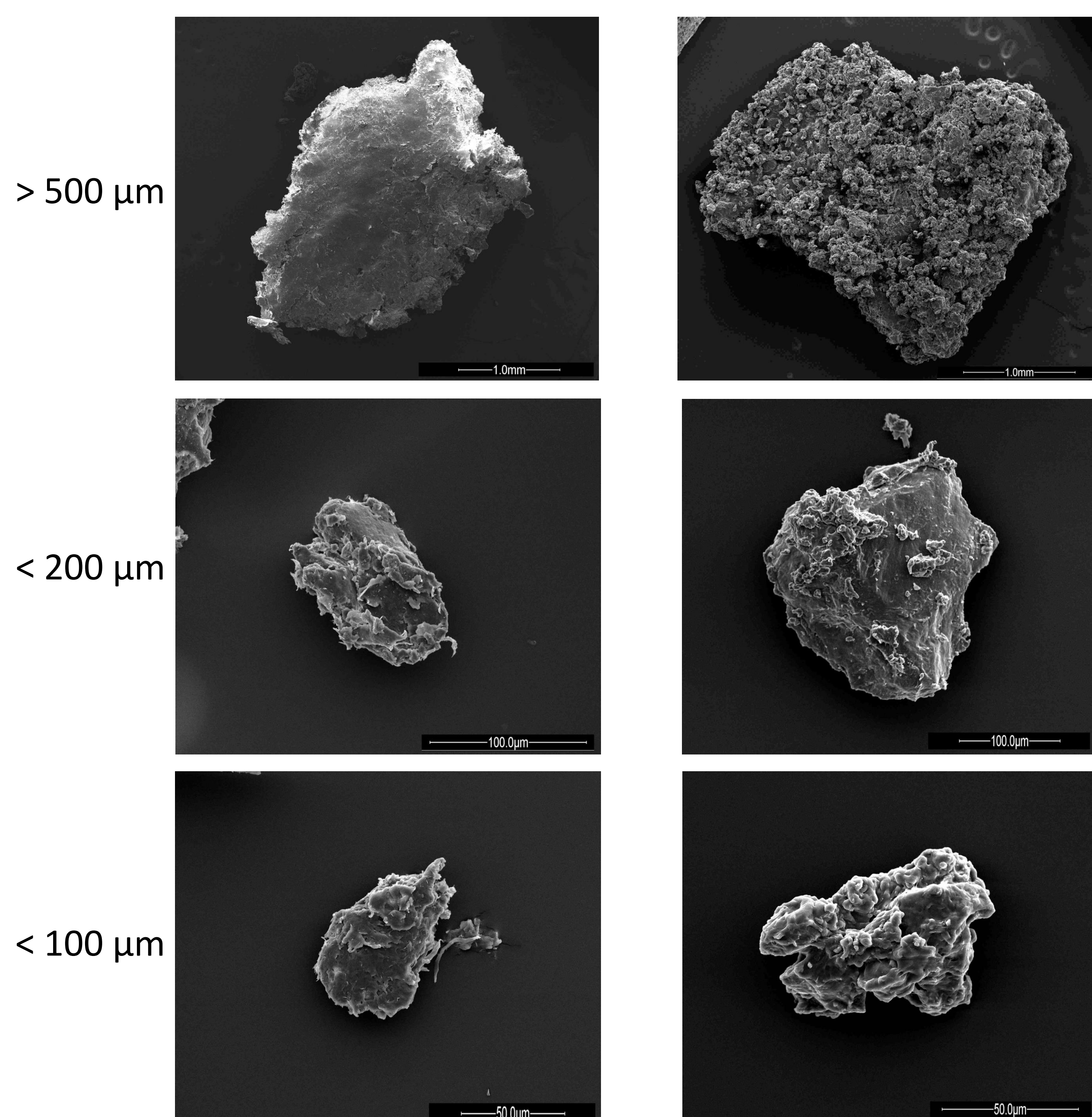
Yield of size fractions of bio-based and conventional plastics after cryogenic milling.



15 min pre-cooling in liquid nitrogen



NPSF (Polylactide-based)      PBE 003 (Polybutylensuccinate-based)



Scanning electron micrographs of cryo-milled bio-based plastics.

4 cycles: 2 min run, 2 min cooling  
8 cycles: 1 min run, 1 min cooling

## Results

- PBE 003 yielded lowest amounts of fractions < 500  $\mu\text{m}$ , < 200  $\mu\text{m}$ , and < 100  $\mu\text{m}$
- Short grinding intervals (8 cycles) doubled the yield of the PBE fraction < 200  $\mu\text{m}$  and < 100  $\mu\text{m}$
- NPSF gave higher yields of fractions < 500  $\mu\text{m}$  and < 200  $\mu\text{m}$  but scarcely < 100  $\mu\text{m}$
- PMMA yielded highest amounts of all size fractions, accounting in total for about 90 % of the applied material
- Long grinding intervals (4 cycles) caused larger aggregations of platelet-like particles (left graphic, upper row)

## Conclusion

- Cryogenic milling is suitable to grind conventional as well as bio-based plastics to microparticle size.
- The effectiveness strongly depends on the plastic material and the grinding/cooling intervals.
- Every plastic needs its own optimized methods and running parameters for best performance