

Impact of $\text{Li}_6\text{PS}_5\text{Cl}$ Comminution on the Densification and Cell Performance of Solid-State Cathodes

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Objectives

Aims of electrolyte **comminution**:

- ✓ Reduction of particle size and thus, increase of the specific surface area
- ✓ Increased contact area with the active material and thus, improved ionic conductivity in the cathode

Aims of cathode **densification**:

- ✓ Improved ionic and electric conductivity
- ✓ Increased power and energy density
- ✓ Defined microstructure
- ✓ Reduced surface roughness

How does the $\text{Li}_6\text{PS}_5\text{Cl}$ comminution influence the cathode densification?

Methodology

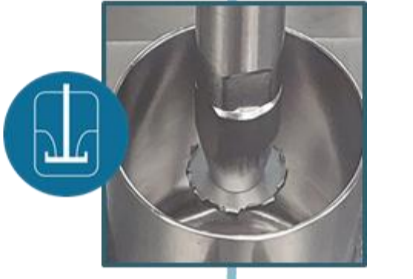
Processing in a glovebox with p-xylene as solvent (35 wt% cathode solids content).

Compound	wt%
$\text{Li}_6\text{PS}_5\text{Cl}$ (LPSCI)	24
$\text{LiNi}_{0.83}\text{Co}_{0.11}\text{Mn}_{0.06}\text{O}_2$ (NCM)	71
Polyisobutylene	3
Carbon black	2

Wet electrolyte
comminution



Slurry
dispersion



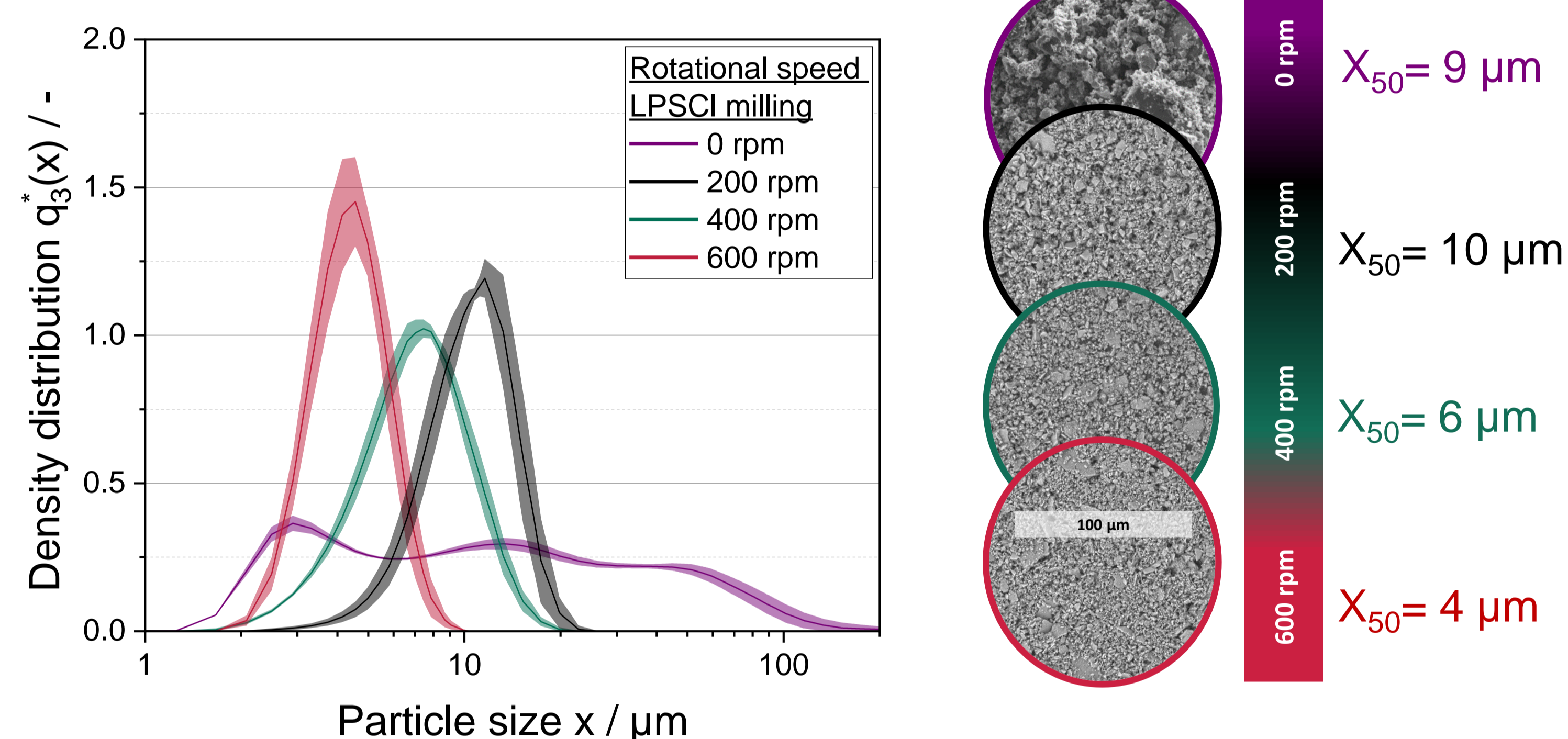
Coating



Uniaxial
compaction

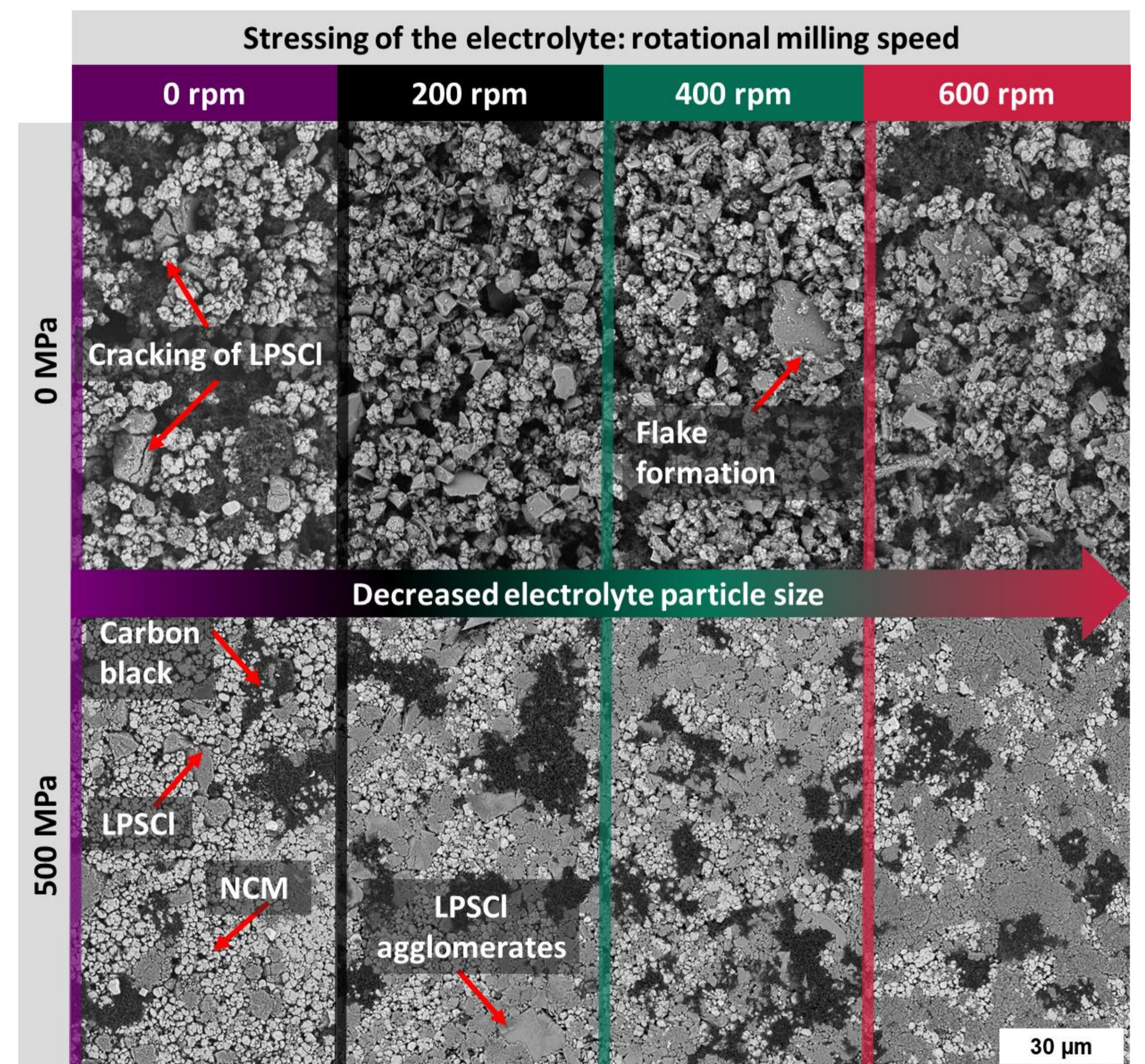


Particle Size

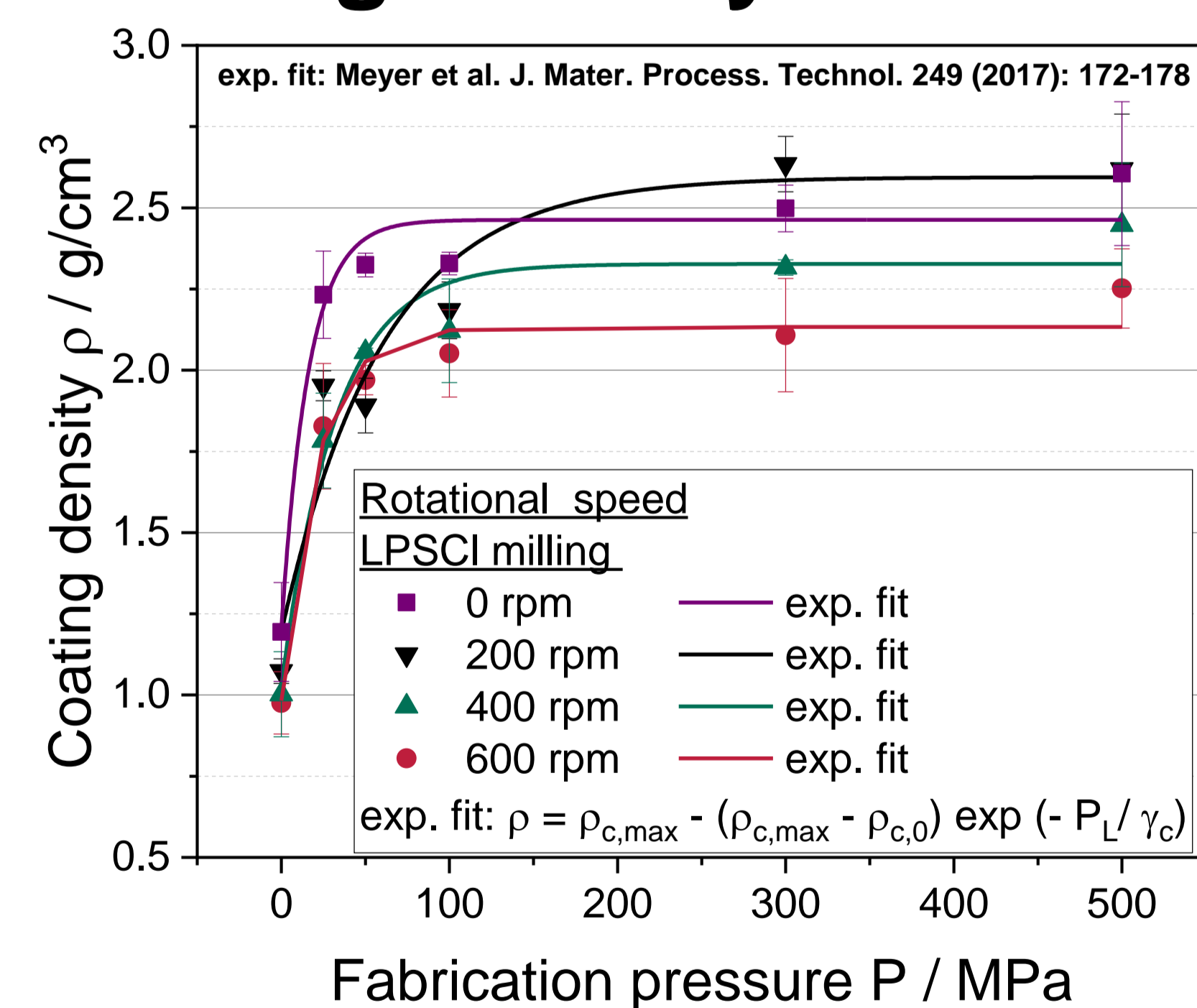


Increase in the rotational milling speed results in a shift of the electrolyte particle size distribution to smaller particle sizes.

Scanning Electron Microscopy



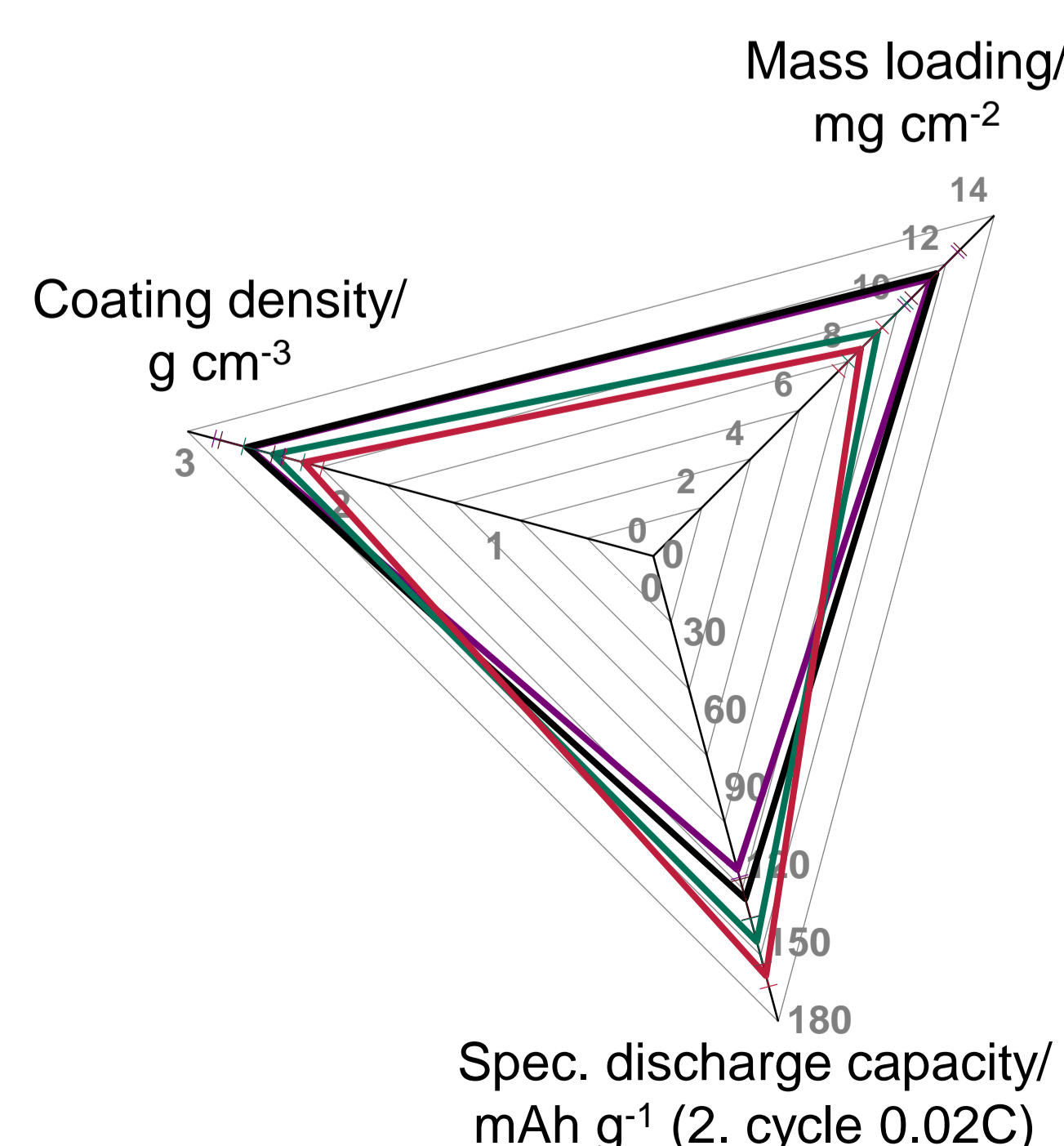
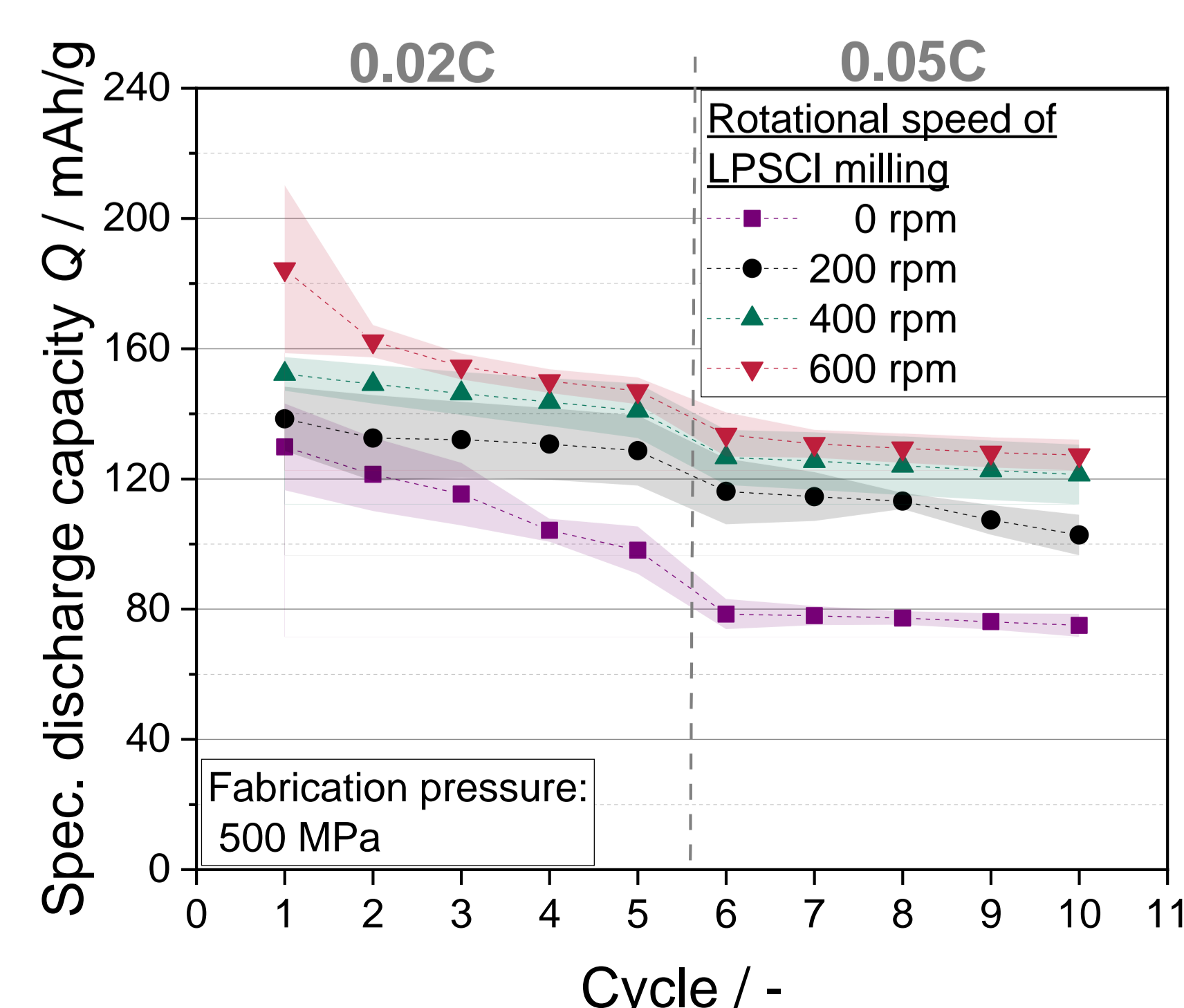
Coating Density



Increase in the rotational milling speed leads to a decrease of the achievable coating density: Smaller electrolyte particle sizes/formed particle flakes increase friction during compaction.

Achievable coating density:
0 rpm = 200 rpm > 400 rpm > 600 rpm

Cell Performance



Conclusion

- The electrolyte particle size was reduced by solvent-based planetary ball milling for subsequent cathode production.
- Better cell performance for cathodes with grinded electrolyte probably due to better contact between the LPSCI and NCM. Increased rotational milling speed of the LPSCI also results in a decrease in the coating density (usually deteriorating cell performance) but also in a decrease in mass loading (improving cell performance).
- This study emphasizes the importance of electrolyte particle size and thus interfacial properties in the composite cathode for solid-state lithium-ion batteries.

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