

Dry Battery Electrode Coating with DRYtraec®

Cost-saving Potential in Battery Electrode Production

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Motivation

- Reduced CAPEX and OPEX required for Competitive Battery Electrode production
- Dry Battery Electrode (DBE) Coating opens a promising approach
- DRYtraec = Dry Transfer Electrode Coating is a key technology

Current state-of-the-art "slurry" process

- Huge equipment footprint
- Toxic organic solvents
- Energy-intensive

Fraunhofer IWS DRYtraec®

- Dry battery electrode coating
- Space- and energy-efficient
- No solvent, no drying

Methodology

- Extrusion-based mixing and fibrillation of LFP400 (95 wt.-%, IBU-tec AG), SC65 (3.5 wt.-%, Imerys), PTFE F104 (1.5 wt.-%, Daikin)
- DRYtraec film formation using 4-roll calender setup

pre-mixing & fine dispersion
loose powder mix
Kneading & PTFE fibrillation
continuous PTFE fibrillation
optimized dry electrode mass

DRYplatform: R&D infrastructure

- Dry battery electrode infrastructure for R&D along the value chain
- R&D topics: material, process, equipment, application
- TRL 1 (small lab scale feasibility) ... TRL 6 (roll to roll prototype scale)

Process Room
TRL-6 DRYtraec® equipment fully digitalized

Analytics Room
• Powder/Mixture characterization
• Electrode characterization

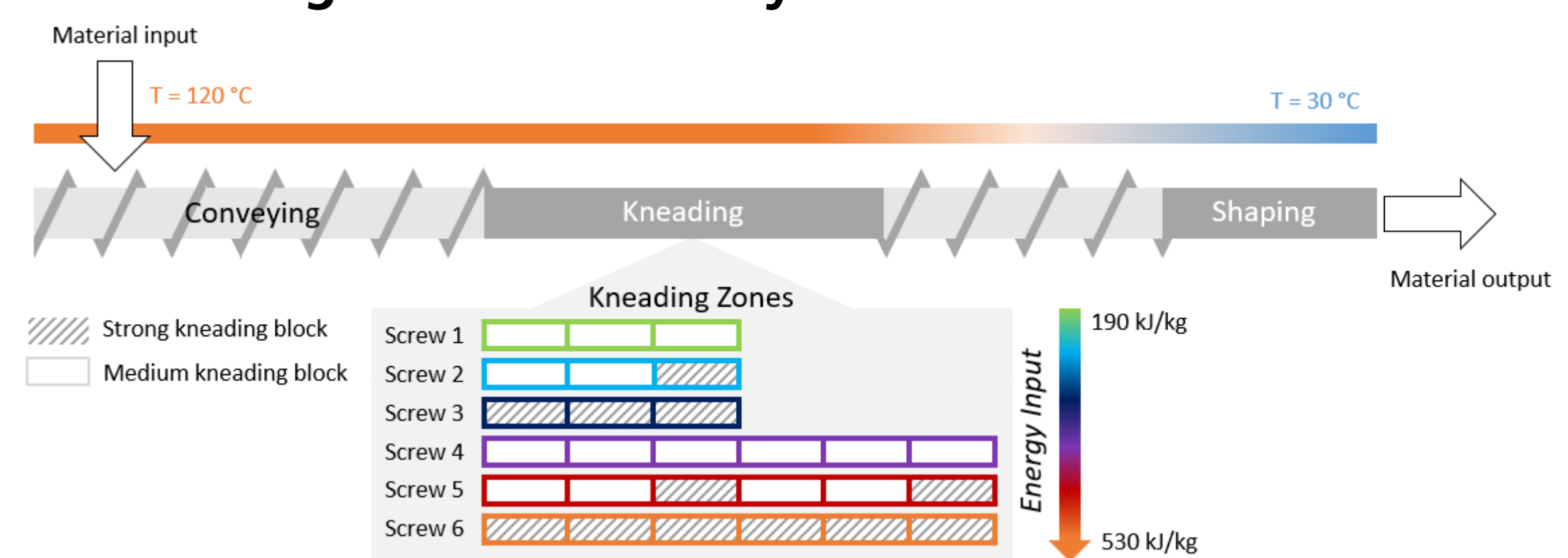
Dry Air Environment
3 dew point modi: -55 °C / -40 °C / ambient humidity

- TRL-6 Process Line** for continuous mixing and coating (up to 10 m/min on 20 cm width tandem coating), prototype cells



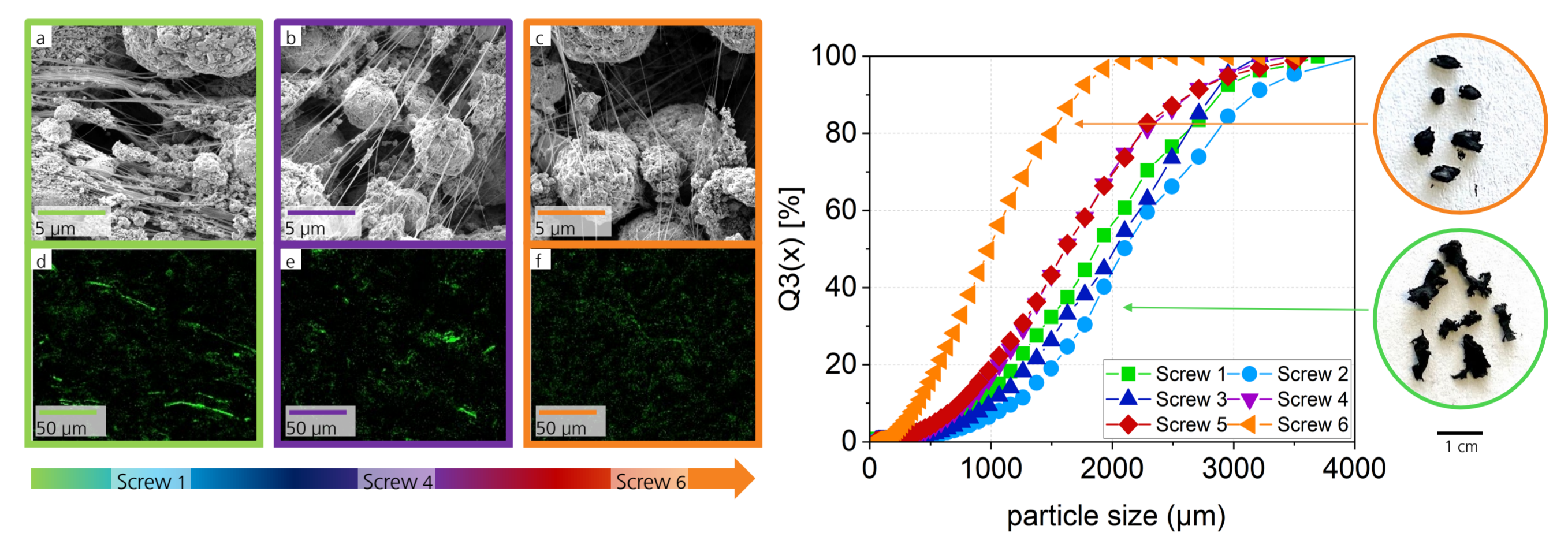
Results

Extrusion mixing of fibrillated dry material for LFP electrodes



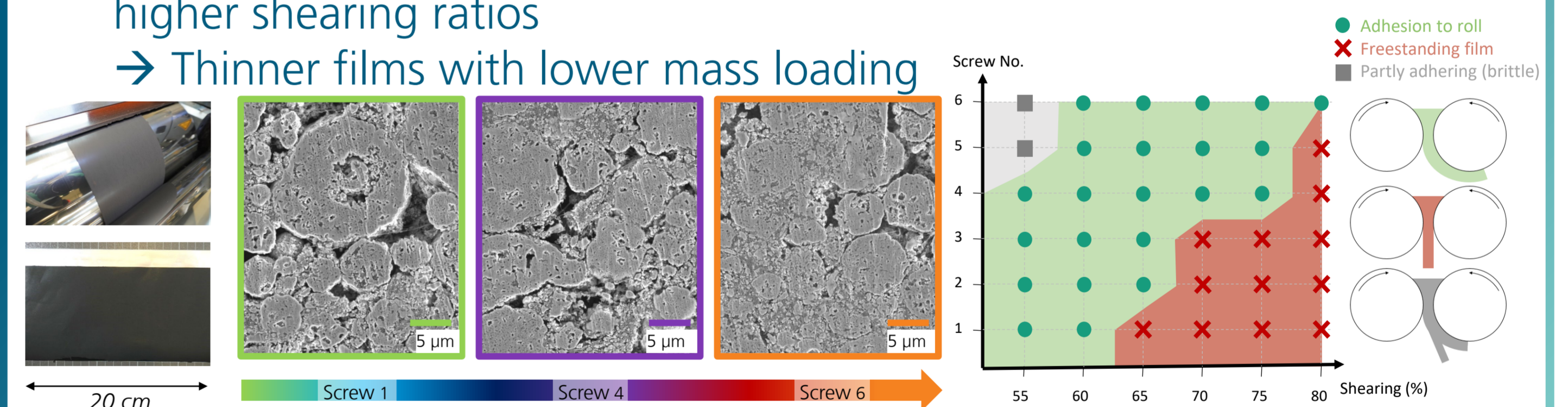
Differences in macro- and microstructure of granules

- Variation of mechanical energy input during extrusion (screw1→screw6) results in differences in thickness and distribution of PTFE fibrils
- Stronger kneading produces smaller and more regularly shaped granules



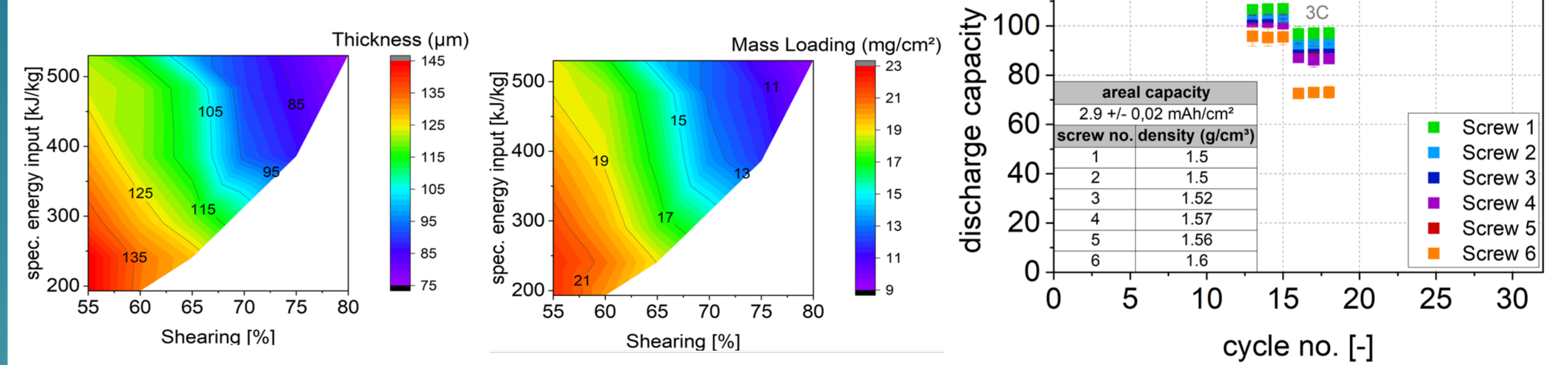
Coatability of fibrillated LFP dry material

- Increasing mechanical energy input in extruder
→ shift of processability window (domain of roll adhesion) towards higher shearing ratios
→ Thinner films with lower mass loading



LFP electrode properties

- Shearing variation allows loading/thickness tuning
- Difference in microstructure observed
- Solid C-rate capability obtained
- Intensive kneading reduces rate capability



Conclusion

- Extrusion can be used as method for mixing and fibrillation in DBE
 - Macrostructural & microstructural properties of extruded material can be varied via variation of energy input during extrusion (fibrillation degree, PSD, rheology...)
 - Varying the shearing in DRYtraec allows electrode property tuning
- Scalable Dry Battery Electrode coating is possible combining cost-efficient continuous extrusion mixing and DRYtraec®.**
TRL-8 demonstration in FFB innovation lab in 2026.