

Calendering process of water-based SPAN-cathodes for Aerospace Application of Lithium-SPAN Batteries

Robert Ebeling^{1,2}, Peter Michalowski^{1,2}, Arno Kwade^{1,2}

¹ Institute for Particle Technology, Technische Universität Braunschweig

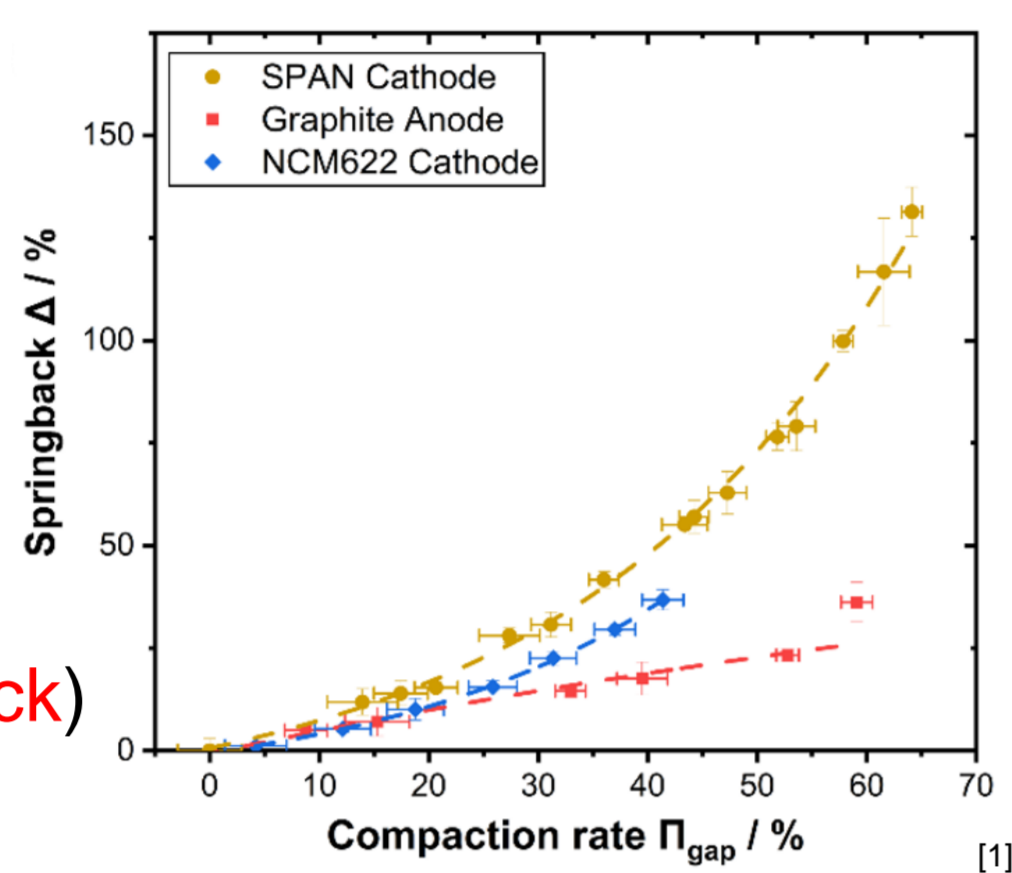
² Battery Labfactory Braunschweig

✉ robert.ebeling@tu-braunschweig.de | ☎ +49 (0) 531 391-94644

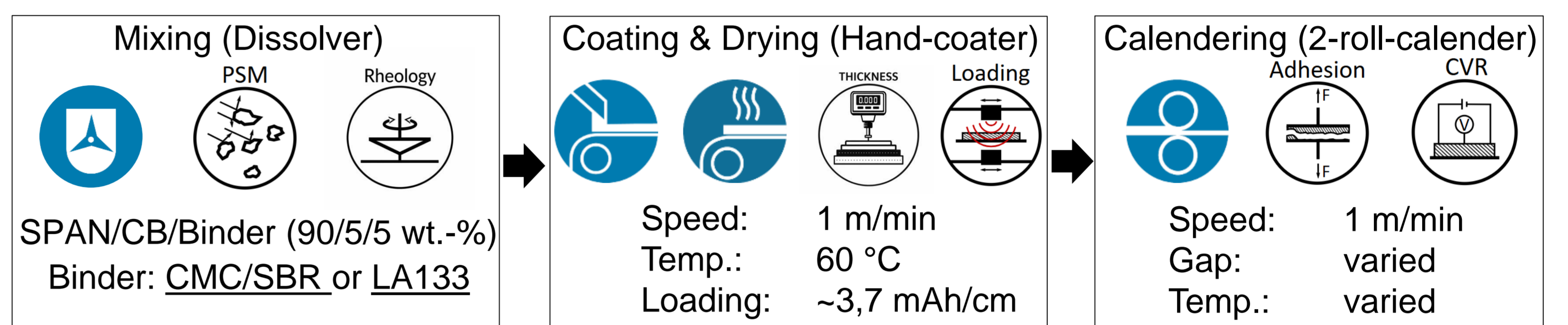
Motivation

SPAN / Li-SPAN-cells:

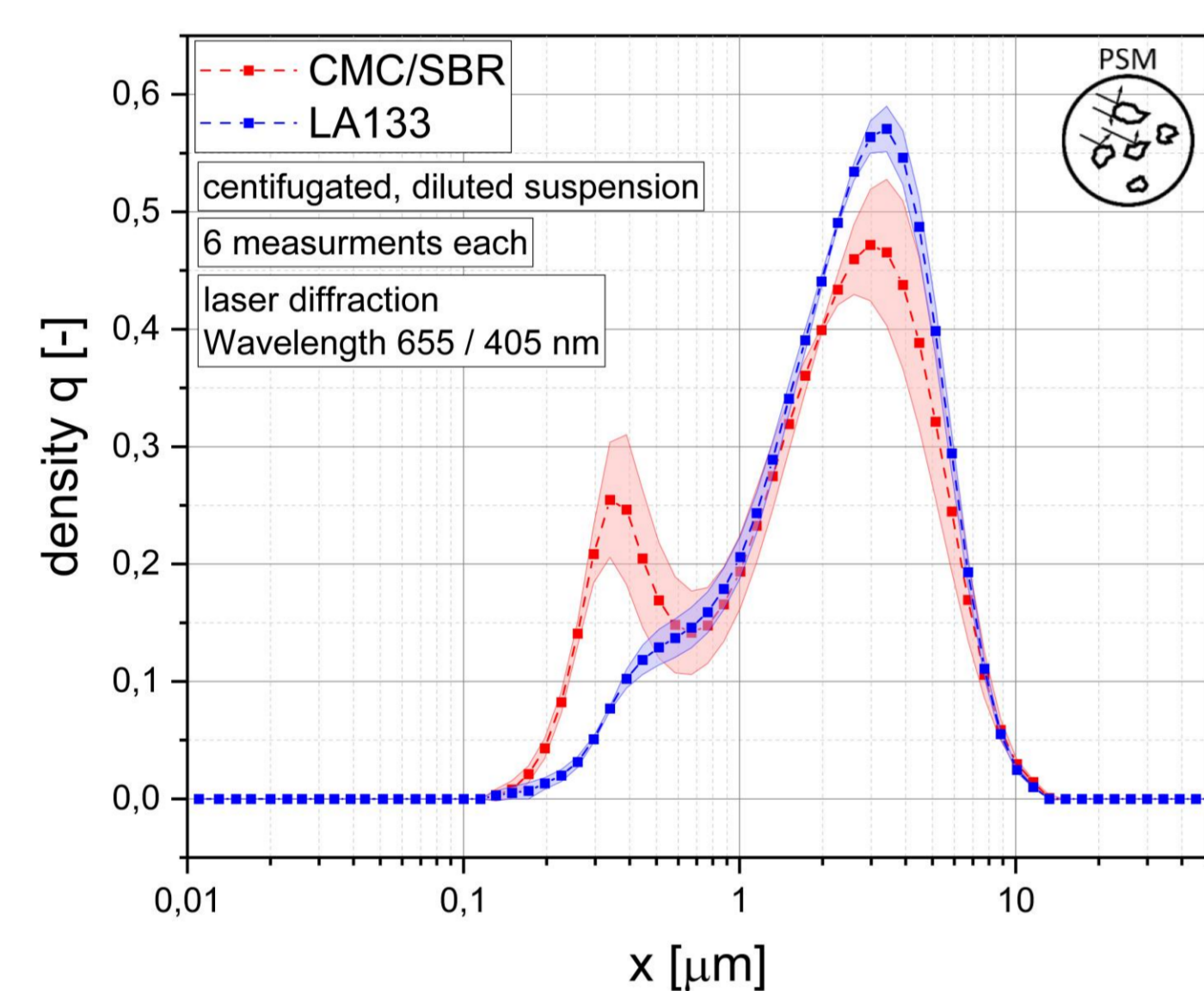
- + suppressed shuttle effect
- + cycling: >1500 cycles @ 1C
- + specific energy: > 350 Wh/kg
- low electric conductivity
- poor compressibility (springback)



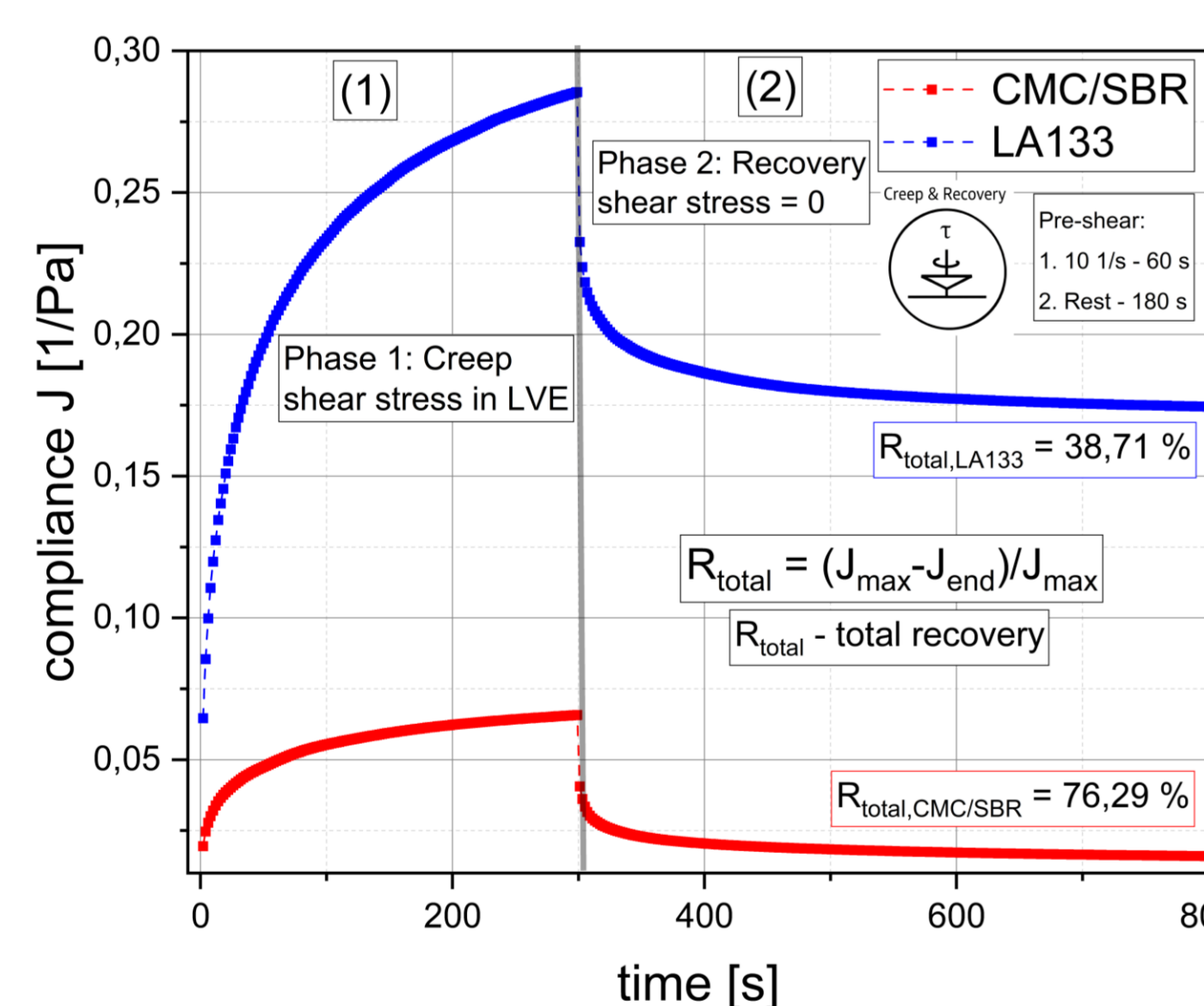
Production Process and Characterization



Binder-dependent suspension

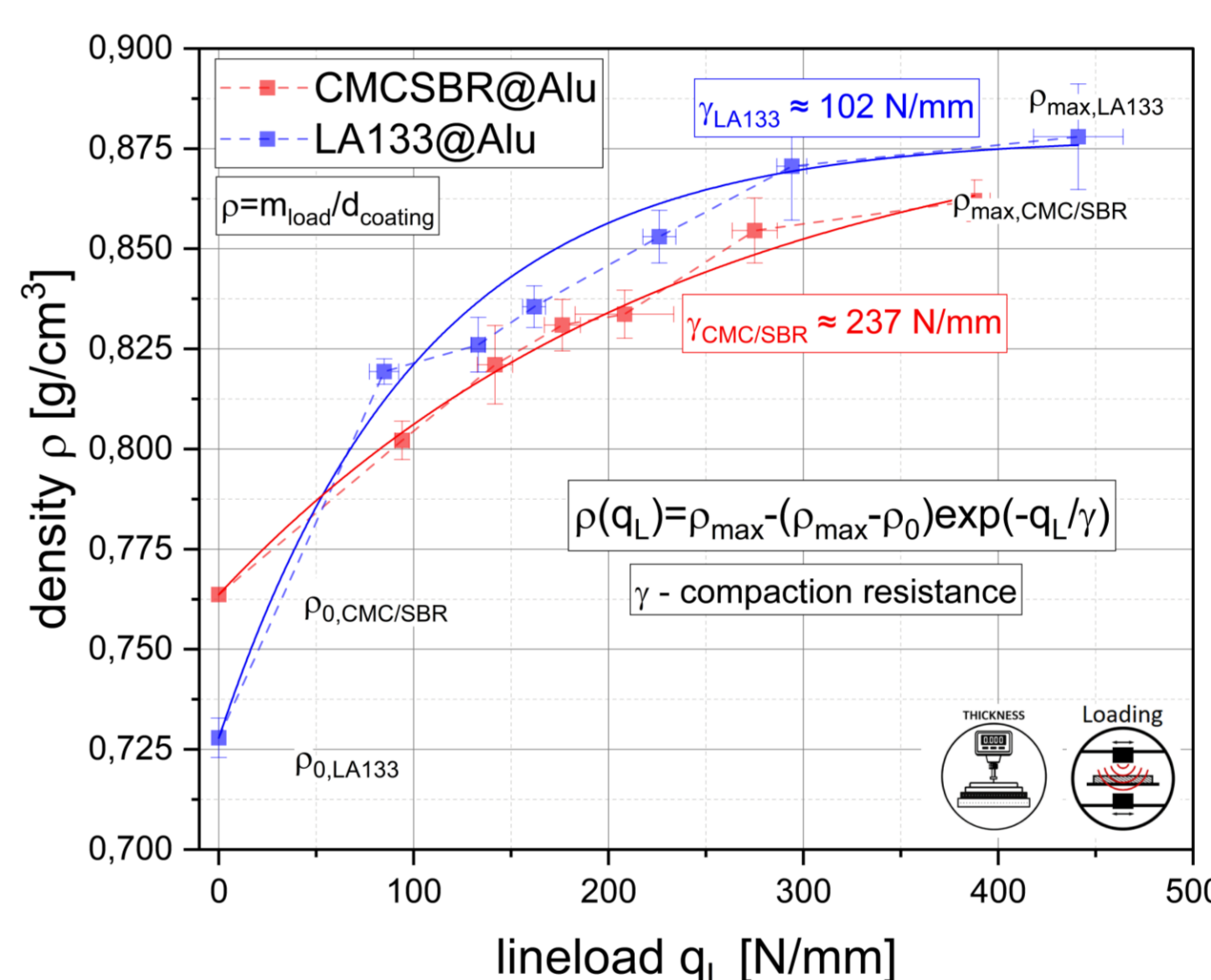


- fine-particle peak
- electrosteric stabilization of CB
- monomodal distribution
- homogeneous network
- LA133 generates **network integrity** over particle-level stabilisation

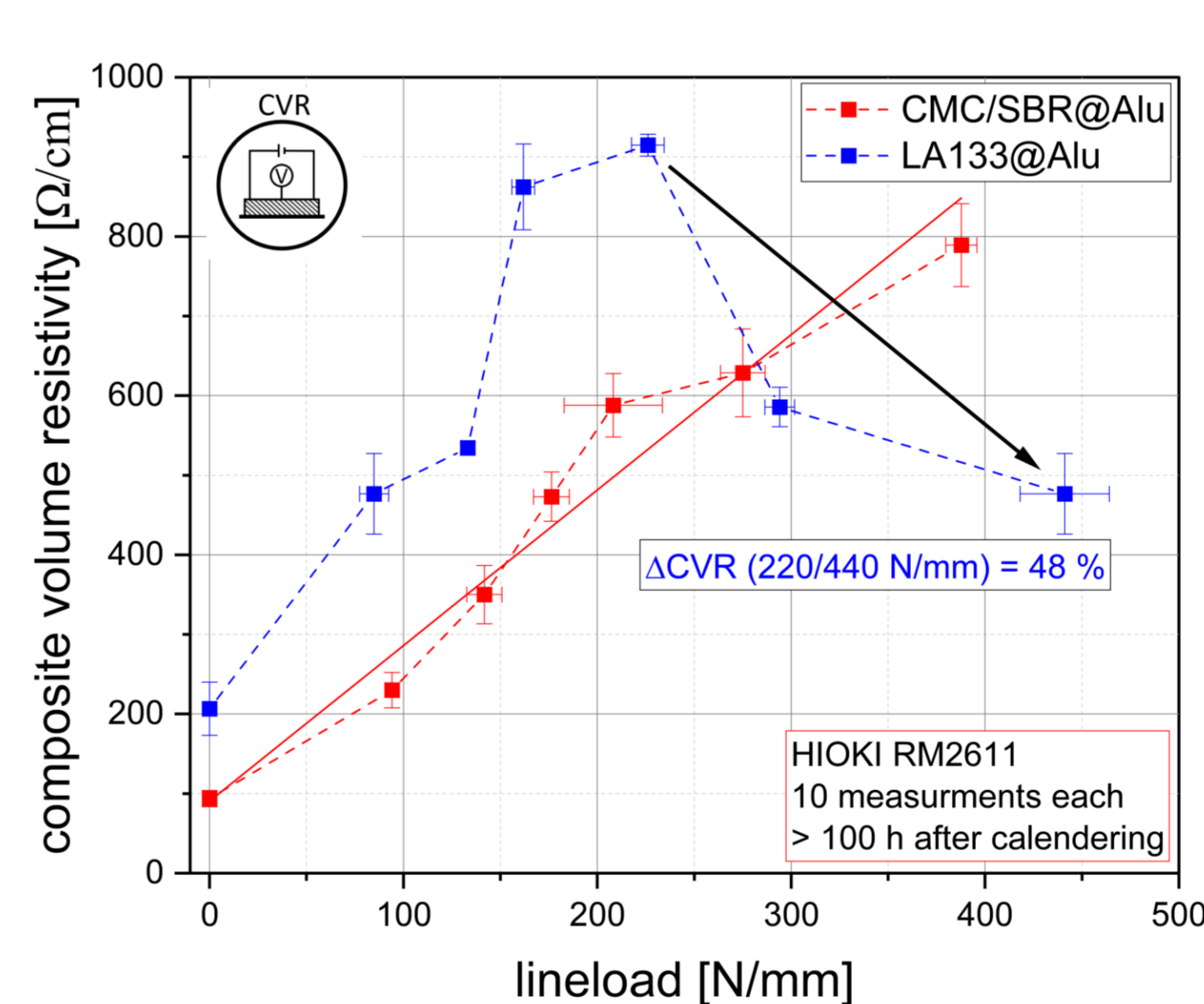


- higher R_{total}
- elastic, reversible deformation
- lower R_{total}
- plastic, irreversible deformation
- LA133's plastic flow behavior is favorable for compaction

Lineload-dependent compaction

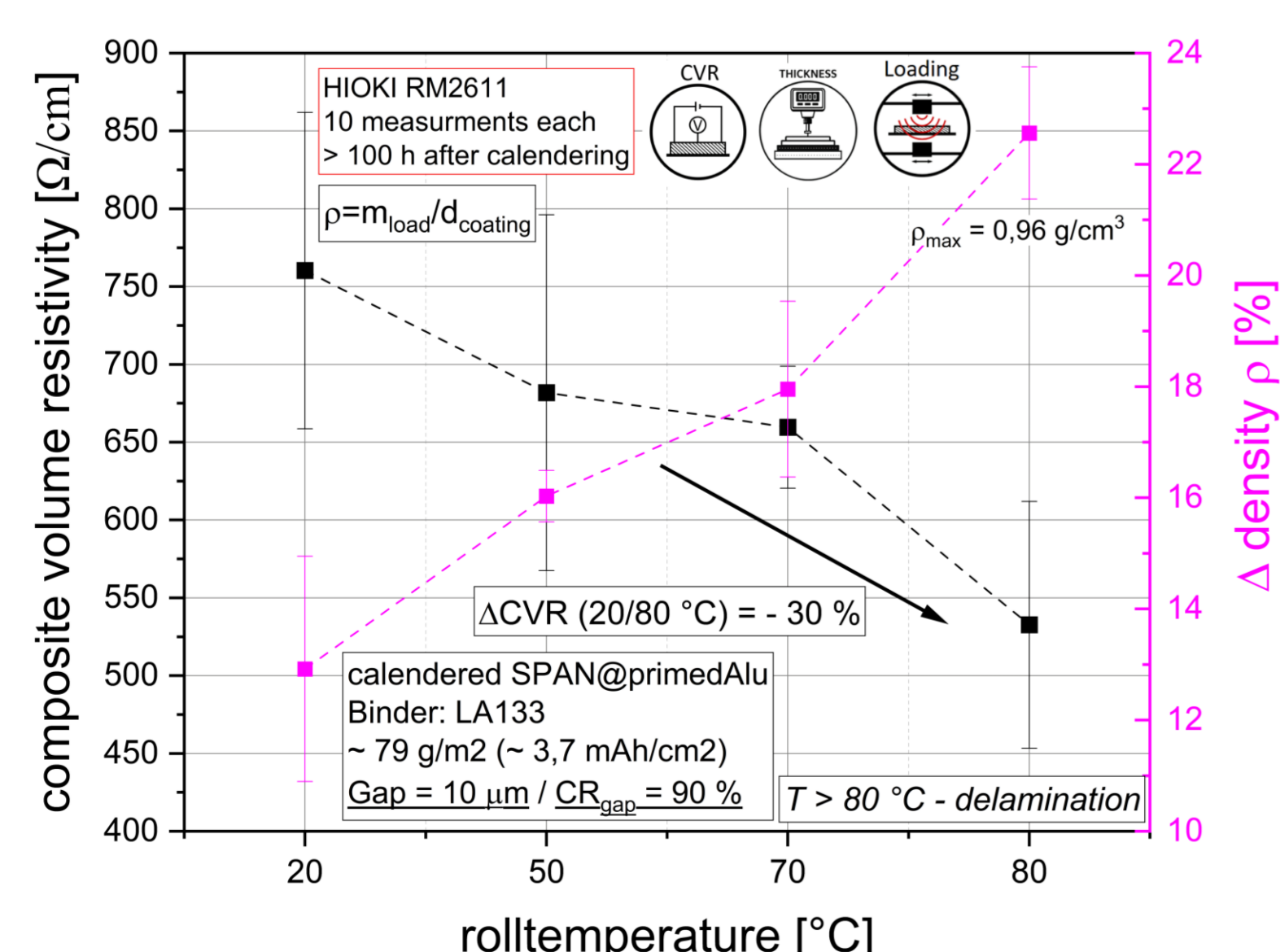


- lower ρ_{max} , higher γ
- more elastic resistance
- higher ρ_{max} , lower γ
- plastic-dominated deformation
- LA133 shows **easier densification** and **efficient particle rearrangement**

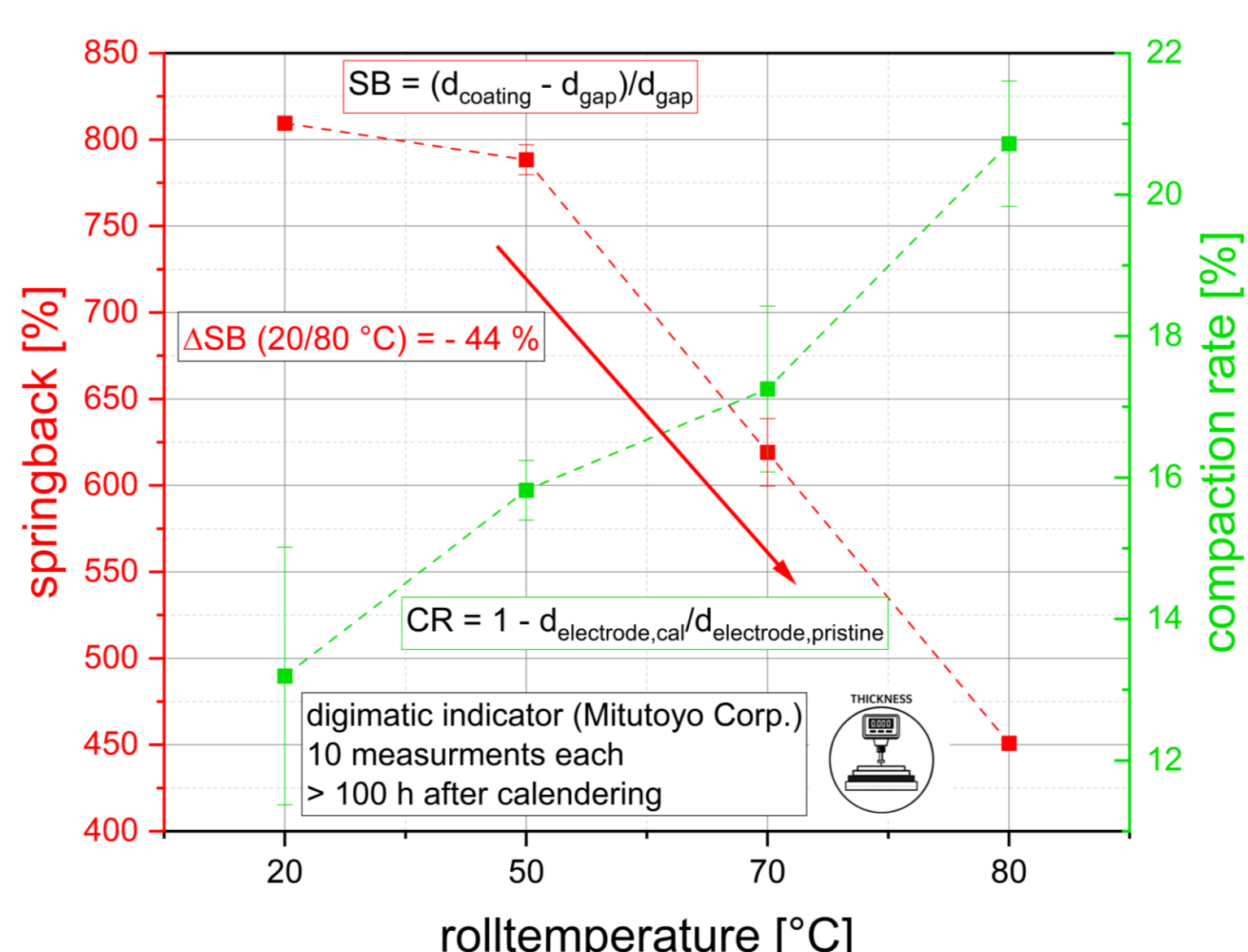


- linear CVR increase
- disruption by elastic recovery
- significant CVR decrease at high q_L
- improved electric percolation
- LA133's plastic network consolidation **enhances electric conductivity**

Temperature-dependent compaction



Thermally activated plastic flow of LA133 ($T > T_g$) locking in densification and promoting **high final density (ρ_{max})** and **improved electric conductivity**



T_g -related binder-softening leads to a strong **reduction in springback** (increased CR) and an irreversible particle rearrangement

Acknowledgements

The authors thank the Project Management Jülich and the Federal Ministry of Research, Technology and Space for the financial support during the Project SulForFlight [No. 03XP0491].



References

- [1] Robin Moschner et al. (2025); Impact of the Sulfurized Polyacrylonitrile Cathode Microstructure on the Electrochemical Performance of Lithium-Sulfur Batteries, *Advanced Science*, DOI: 10.1002/advs.202415436
- [2] Chris Meyer et al. (2017); Characterization of the calendering process for compaction of electrodes for lithium-ion batteries, *Journal of Materials Processing Technology*, DOI: 10.1016/j.matprotec.2017.05.031
- [3] ADEKA Corp., Battery adhesive, water-based battery adhesive, and lithium-ion battery negative electrode sheet, Japan Patent: JP7480310B2 (2024)