

Towards scaling up in sustainable electrode production

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The maturity of a technology can be well described by the Technology Readiness Level (TRL) scale, to estimate how far a technology is from commercialization. Frith et al. proposed a specific TRL for Li-ion Batteries (LIBs) that highlights the gap between the laboratory studies and the industrial level [1]. This gap is considered one of the bottlenecks in the commercialization of new technologies and it is related to the absence of pilot lines at laboratory levels. When cell production is concerned, to scale-up the production process is strongly depending on the chemical composition of the electrode, the interphase with the electrolyte and its composition and the chemical-physical properties of the slurry, influenced by the final rheological properties.

The electrode production starts with the mixing of the electrode components (active material, conductive additive, binder and solvent). The used techniques can be very different depending if this is performed at laboratory scale (e.g. magnetic stirrer) or industrial level with bigger slurry amount (e.g. planetary mixer). This technology permits to increase the slurry stability, in particular for water-based production, so avoiding unwanted phenomena such as aggregation and sedimentation. The increase of the solid content of the slurry can limit the sedimentation phenomena, even if it can lead to a higher viscosity, creating problems during the coating step [2]. The coating is the core step of the electrode production strongly affected by the scale of production: at the laboratory scale, the process is discontinuous and the main instrument chosen for the deposition is the tape casting (doctor blade), while the high yield needed at the industrial level requires a process fully automated and continuous, switching to different types of technologies (slot die coater) [3].

Our research aims to better understand how innovative active materials and aqueous binders perform at different TRL levels to anticipate and propose new solutions to overcome the challenges that the industry will face.

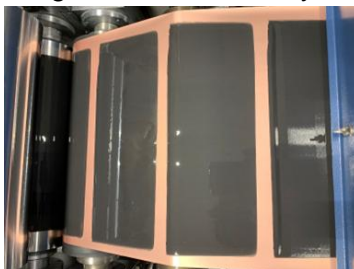


Figure 1: Anode coating on roll-to-roll machine

[1] J.T. Frith, M.J. Lacey, U. Ulissi, *Nature Communications* (2023) 14, 420

[2] W.B. Hawley, J. Li, *J Energy Storage* (2019) 25

[3] S.N. Bryntesen, A.H. Strømman, I. Tolstorebrov, P.R. Shearing, J.J. Lamb, O. Stokke Burheim, *Energies* (2021) 14, 1406