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TOWARDS SCALING UP IN SUSTAINABLE ELECTRODE PRODUCTION

Elisa Ravesio[1,*], Valentina Sumini[2], Giorgio Montinaro[1], Daniele Versaci[1], Silvia Bodoardo[1]

[1]Dip. Applied Science and Technology (DISAT), Politecnico di Torino, C.so Duca degli Abruzzi 24, 10029 Torino, Italy; [2]Coesia Engineering Center, Coesia, via Battindarno 91, 40133 Bologna, Italy
***Corresponding author:** elisa.ravesio@polito.it*

The maturity of a technology can be well described by the Technology Readiness Level (TRL) which is a 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 [Frith et al., 2023]. This gap is considered one of the most important bottlenecks in the commercialization of new technologies and it is strictly related to the absence of pilot lines at laboratory levels. When cells production is concerned, to scale-up the production process is challenging and it 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, which is 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 (commonly with a simple magnetic stirrer) or industrial level with bigger slurry amount (e.g. in a planetary mixer). The use of this technology permits to increase the slurry stability, in particular for more environmental friendly water-based production, so avoiding unwanted phenomena such as aggregation and sedimentation, often due to hydrogen bonding. The increase of the solid content of the slurry can limit the sedimentation phenomena, even if it can lead to the increase of the viscosity which can create problems during the coating step [Hawley et al., 2019].

The coating is the core step of the electrode production strongly affected by the scale of production (from lab to industrial scale): at the laboratory scale, the process is discontinuous while the high yield needed at the industrial level requires a process fully automated and continuous [Bryntesen et al., 2021]. In particular, at the laboratory level, the main instrument chosen for the deposition is the tape casting

(doctor blade), while at the industrial level the technology switch to different types of technologies (slot die coater) [Bryntesen et al., 2021].
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.

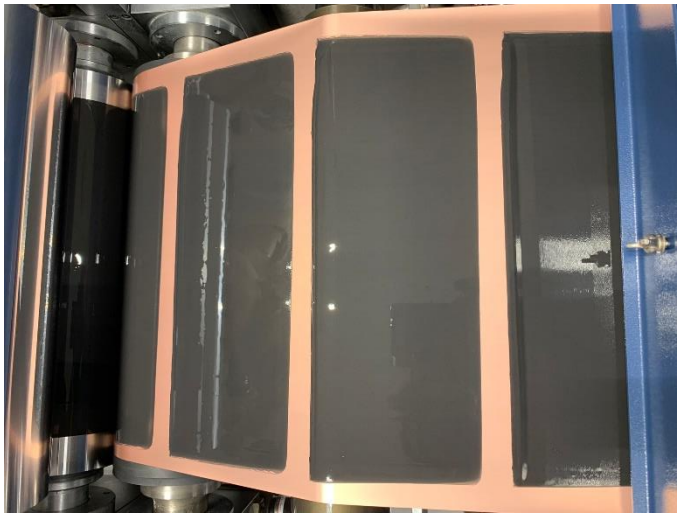

Figure 1. Anode coating on roll-to-roll machine

Key words: *TRL, Pilot line, Electrode production, Sustainability*

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