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Packaging – Technology Review

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Abstract. This paper gives an overview of battery packaging concepts, their specific advantages and drawbacks, as well as the importance of packaging for performance and cost. Manufacturing processes, scaling and automation are discussed in detail to reveal opportunities for cost reduction. Module standardization as an additional path to drive down cost is introduced. A comparison to electronics and photovoltaics production shows “lessons learned” in those related industries and how they can accelerate learning curves in battery production:

Different cell chemistries basically define the “heart” of the battery and lay the foundations for its suitability for a specific application – from consumer to industrial, from stationary to mobile, optimized for high power or high energy. Despite these important “inner values”, it is the packaging that greatly influences important performance parameters like lifetime, cyclability, ruggedness, safety as well as cost. In the end, packaging adapts the battery to the specific needs of an application: sealing, form factor, temperature and charge monitoring and as well as overall management are determined by the design and make of modules and packs. For lithium ion chemistries a battery management system is essential to create a reliable, lasting and safe battery – the package adds the “brains”.

Cost is a great driver for the success of electromobility or storage for renewable energy. However, only mass production will enable affordable solutions here. At least for the big form factors there is a lot of room for optimization: For a fab, a number of alternative processes and process parameters have to be chosen. Inspection is crucial. Furthermore, automation and line integration will greatly enhance yield, precision and workplace safety. VDMA has set up a roadmapping process for production solutions which gives an insight to future developments in this field.

Whereas the packaging of e.g. consumer and starter batteries have been widely standardized, manufacturers of lithium ion batteries introduced new formats of cylindrical, prismatic and pouch shapes. Especially for high-power applications for electric vehicles or renewable energy buffering this is a differentiation factor for the OEMs. With small volumes in those markets however, this is hindering scaling. At least at the module level there have been attempts to push for standardization as an additional route to cost reduction.

Electronics and photovoltaics employ comparable processes to battery productions, like deposition techniques, wiring, soldering, handling, automation and clean room environment. This paper finally also shows how the experience of machine makers in those fields can pave the way to high-power battery mass production – and therefore make electromobility and energy storage affordable for everybody.