

A Concept for Flexible Battery Cell Manufacturing from Low to Medium Volumes

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Abstract : The competitiveness and success of new electrical energy storages such as battery cells are significantly dependent on a short time-to-market. Producers who decide to supply new battery cells to the market need to be easily adaptable in manufacturing with respect to the early customers' needs in terms of cell size, materials, delivery time and quantity. In the initial state, the required output rates do not yet allow the producers to have a fully automated manufacturing line nor to supply handmade battery cells. Yet there was no solution for manufacturing battery cells in low to medium volumes in a reproducible way. Thus, in terms of cell format and output quantity, a concept for the flexible assembly of battery cells was developed by the Fraunhofer-Institute for Manufacturing Engineering and Automation. Based on clustered processes, the modular system platform can be modified, enlarged or retrofitted in a short time frame according to the ordered product. The paper shows the analysis of the production steps from a conventional battery cell assembly line. Process solutions were found by using I/O-analysis, functional structures, and morphological boxes. The identified elementary functions were subsequently clustered by functional coherences for automation solutions and thus the single process cluster was generated. The result presented in this paper enables to manufacture different cell products on the same production system using seven process clusters. The paper shows the solution for a batch-wise flexible battery cell production using advanced process control. Further, the performed tests and benefits by using the process clusters as cyber-physical systems for an integrated production and value chain are discussed. The solution lowers the hurdles for SMEs to launch innovative cell products on the global market.

Keywords : automation, battery production, carrier, advanced process control, cyber-physical system

Conference Title : ICAMET 2017 : International Conference on Advanced Manufacturing Engineering and Technologies

Conference Location : Bangkok, Thailand

Conference Dates : October 26-27, 2017