PRESS RELEASE

Handbook on Smart Battery Cell Manufacturing: digitization to conserve resources

Electromobility is causing an explosion in demand: Large-scale production of battery cells needs gigafactories, and these consume vast amounts of energy and raw materials. A research team at the Center for Digitized Battery Cell Production at Fraunhofer IPA has now investigated how digitization of manufacturing can not only optimize production processes and save materials and energy, but also extend battery service life.

Lithium-ion batteries are a growth market. According to McKinsey management consultants, 80 gigafactories will be needed in Europe alone by 2040 to equip electrically powered cars, buses and trucks. The production of these cells is energy-intensive – in the case of a passenger vehicle with cylindrical cells, 7,000 to 10,000 cells are currently required per battery – but also resource-intensive: In addition to lithium, the cells also contain nickel, manganese and cobalt, graphite, polymers and electrolytes. The authors of the "Handbook on Smart Cell Manufacturing" at the IPA have calculated that the operation of 40 gigafactories alone will require the equivalent energy output of seven nuclear power plants, and this does not even take into account the energy required to extract the raw materials and transport them to the factories.

As Professor Kai Peter Birke, head of Electrical Energy Storage Systems at the University of Stuttgart, Head of the Center for Digitized Battery Cell Production at Fraunhofer IPA and editor of the handbook explains: "To make production efficient and sustainable, it is essential to optimize battery cell production. For the most part, battery cell production today is still at the level of the automotive industry in the 1960s: You try things out, wait to see if they come up to scratch in practice and then keep adjusting the manufacturing process. This trial-and-error method is not only very inefficient, but also tedious and involves heavy consumption of energy and resources."

Avoid rejects, save energy

For example, until now, between around 6 % and 16 % of battery cell production consists of rejects. These have to be separated out, transported away and disposed of. "Every percent we can save here is a gain for companies and for the environment," emphasizes researcher and manager Professor Birke, adding: "The same applies to energy: The more efficiently a factory operates, the lower its electricity costs and – if fossil fuels are used – the lower its greenhouse gas emissions."

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The team of authors is convinced that the key to conserving resources and to energy-efficient battery cell production is digitization. Digitized production control not only allows manufacturing processes to be accelerated and flexibly adapted to customer requirements, but also allows quality defects to be detected at an early stage. Components that do not meet the criteria can be separated out and digital defect analysis can also be used to quickly identify the causes of poor product quality and readjust the manufacturing processes. This saves time, materials and energy.

"The data collected during production can then be used to create a profile for each cell that accompanies it throughout its service life," explains Prof. Birke. Such a profile would contain, for example, information on the materials from which the cell was manufactured, the substances that make up the electrodes and how much electrolyte was added and here. A smart workpiece carrier which digitally determines the weight, for instance, was developed at the IPA for this specific purpose.

Digital profiles help save money

In fact, such a digital profile, which can be accessed via a QR code on the surface of the cell, would help to make its use more efficient, Prof. Birke points out: "The service life of finished batteries depends on the capacity of the individual cells – the smaller the differences in capacity, the longer the battery service life. Thanks to digital mapping, battery manufacturers would be able to find out the capacities of each individual cell. In turn, this would enable them to select specific capabilities and combine them to create high-quality batteries." During operation, the profile would help the battery management system manage the charging process in such a way that the utilization of each cell would be maximized. The battery management system also determines the performance of the cells. This information would be helpful for recyclers, who need to pick out the best-performing cells for recycling. The rest could be broken down by type and put to a new use.

"Such comprehensive digitization of the entire life cycle is currently still a pipe dream," Prof. Birke emphasizes. "However, our research shows that investment in the digital transformation process would pay off significantly for manufacturers, because they could not only save material and energy costs, but also improve their products."

Handbook on Smart Battery Cell Manufacturing
The Power of Digitization, 488 pages
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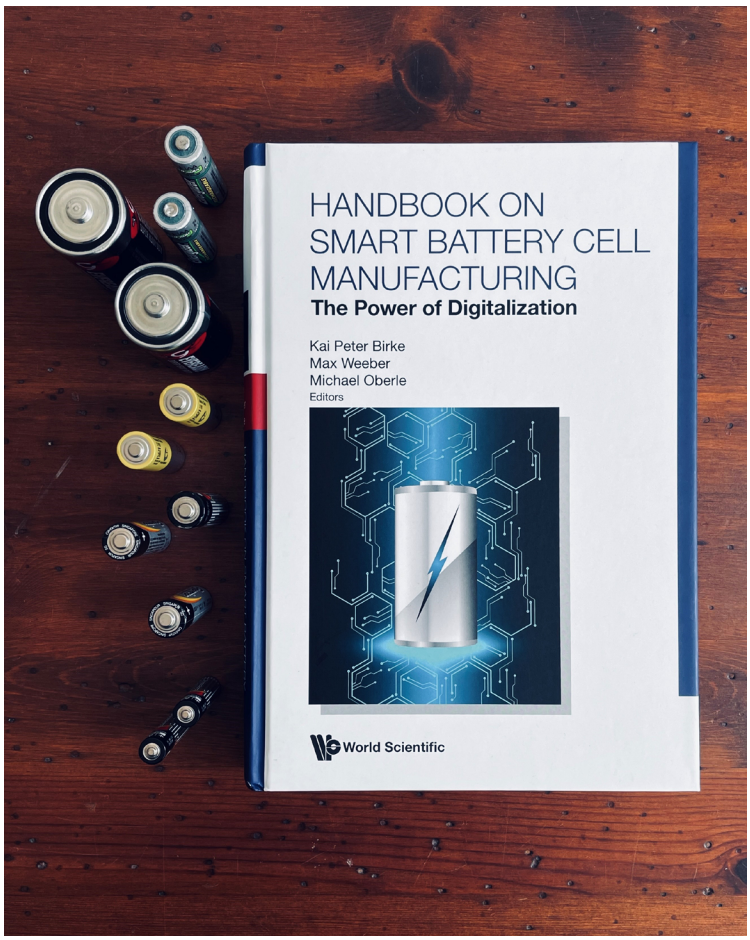

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