Introducing the Synthetic Battery Modeling Toolchain

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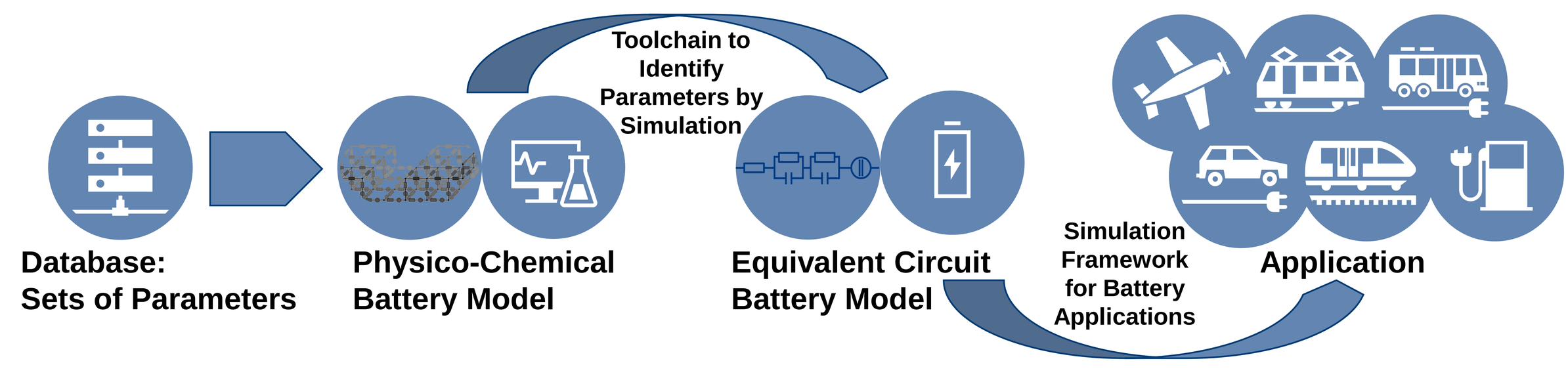
Abstract

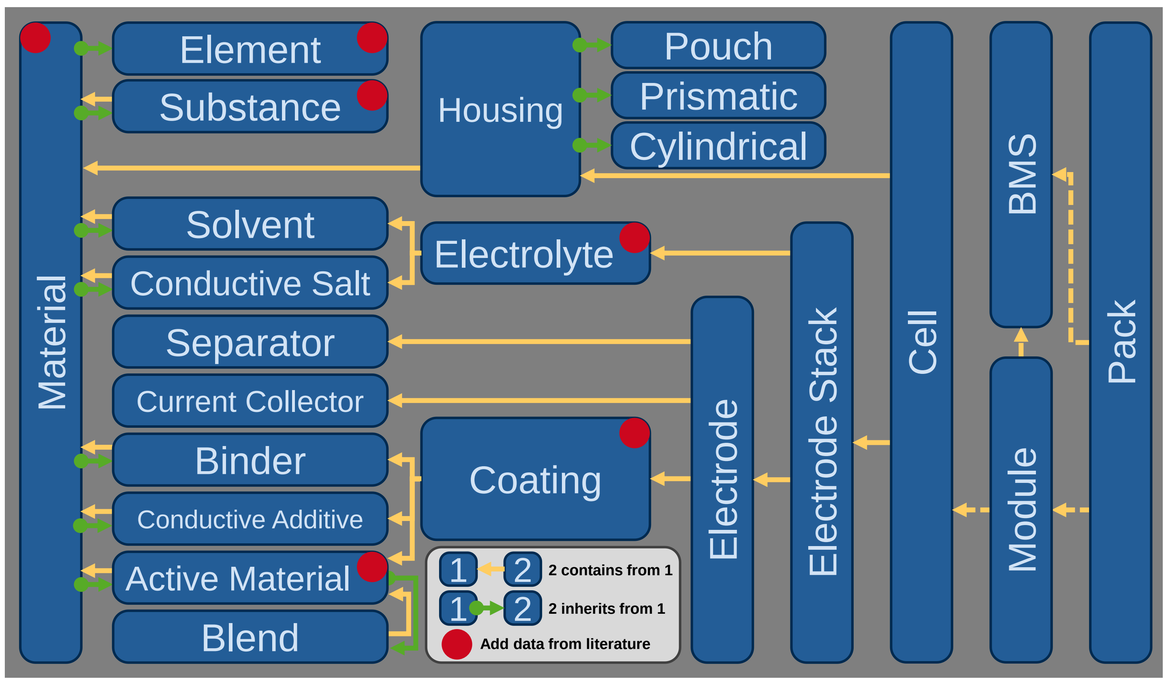
Future battery materials are frequently published in the scientific literature. The influence of these materials on the actual cell performance cannot be easily estimated from the material properties only. However, since constructing a prototype is time- and money-intensive, it is advantageous to make an initial approximation on a simulative basis. For this purpose, we developed the "Synthetic Battery Modeling Toolchain", which can be used to make assumptions about the electrical behavior.

Conclusion

With the toolchain, we have succeeded in virtually redesigning existing battery cells on the basis of data published in the literature and comparing them with measurement results. The calculated parameters match the real parameters with sufficient accuracy. The electrical behavior of the virtually designed battery cells can also be estimated with the toolchain. The output of the toolchain is, besides a data sheet-like overview of the core variables, an electrical equivalent circuit model of the battery.

Structure



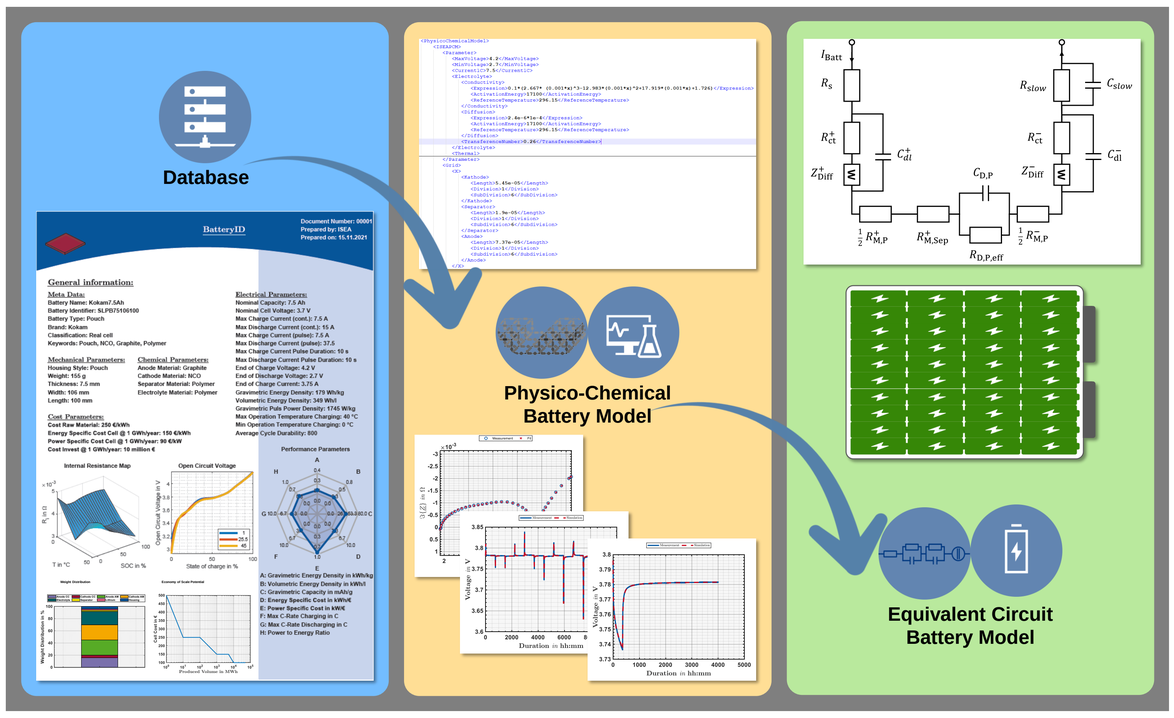


Database

Beginning at the material level, our calculations mimic the production process of lithium-ion battery cells. The parameters of each interim product, such as coating or electrolyte, are also computed from the algorithms. This is one major benefit, because it enables to easily vary parameters on any different stage in the cell design. Examples are different housings, active materials, capacities or electrode thicknesses.

Parameter Identification

The cell parameters calculated in the database serve as input for the physico-chemical battery simulation. Here, simulations are performed analogous to electrochemical impedance spectroscopy, as well as to dynamic pulse or relaxation profiles. The results from this are used as input for the parameterization of an electrical equivalent circuit model, which can be used to simulate entire battery packs.



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