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Editorial

High-Capacity Cells and Batteries for Electric Vehicles

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The automotive sector is rapidly accelerating its transformation towards electric mobility, and electric vehicle (EV) sales have been increasing year after year since the beginning of the decade.

Due to their overall performance, lithium-ion batteries currently dominate the electric vehicle market. Each year, car manufacturers launch new models, increasing the average capacity of electric vehicle batteries. This is achieved, in part, through making bigger batteries, which lead to an increase in the vehicle cost, weight and use of more critical raw materials.

Although prices are lowering, Li-ion batteries still do not have enough energy density to substantially decrease the weight of vehicles, and EVs are around 50% heavier than common internal combustion engine vehicles (ICEV); thus, using high-energy cells is an intriguing possibility that we are being called on to explore.

This Special Issue aims to evaluate several issues concerning high-capacity batteries, and the papers published analyze one or more of the topics or respond to the following questions:

- Upcoming battery technologies: analyzing their relevant benefits but also presenting their shortage or performance issues;
- From cell tests to battery packs for EV;
- New packaging strategies and configurations;
- Weight versus consumption and overall performance of electric vehicles;
- The role of battery management systems in maximizing the capacity of batteries;
- Ageing and lifespan analysis. Higher capacity means fewer cycles and, thus, longer lifespan in real applications;
- End of life;
- Beyond the electric vehicle:
  - Circular economy strategies and battery second life;
  - Recycling;
- Environmental impact;
- Avoiding the use of critical and/or toxic materials;
- When will capacities stop increasing?
- The charge of high-capacity electric vehicle batteries;
- Reviews and comparisons of technologies.

This Special Issue includes four quite extensive articles and reviews that perfectly state some of the critical issues that current EVs face and that need to be considered, either during their lifetime or once they reach the end of life.

In the first place, one of the issues facing most car manufacturers is that EV batteries degrade with time and use. Increasing our knowledge of how they age is what

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Geisbauer et al. [1] analyzed in their *Comparative Study on the Calendar Aging Behavior of Six Different Lithium-Ion Cell Chemistries in Terms of Parameter Variation*. In this study, six 18650-type cells were cycled under different conditions to evaluate their performance loss. The chemistries of the analyzed cells were: LFP, NMC, NCA, LCO, LMO and LTO, and the focus of this work was on the calendar aging effect.

During the lifetime of an EV, though, aging is not the only thing that society should look at. Sadly, car accidents are more common than is desirable, and as the number of EV sales increases, the possibility that one of these vehicles will be involved in such a situation increases. However, how the security of these vehicles in an accident should be handled is not yet so clear, and, nowadays, the fear of electrocution or the impossibility to extinguish any fire coming from the batteries are issues to study. This is the field analyzed in the second article, lead by Wöhrl et al. [2], in their review on *Crashed Electric Vehicle Handling and Recommendations—State of the Art in Germany.*

In any case, being for reasons of crashes or aging, the EV will eventually be retired from our streets. Many questions appear at this point, as EV batteries are expected to be still performant for non-traction purposes at the EV end of life. To further understand the sustainable possibilities of recycling or remanufacture, Kotak et al. [3] performed a review, titled *End of Electric Vehicle Batteries: Reuse vs. Recycle*, which analyzed both possibilities. The study concludes that, although battery reuse is sold as an interesting argument for car manufacturers, it is not enough to warrant the sustainability of EVs and less to cover most of them at the end of life. Thus, Recycling will be needed sooner or later. Nonetheless, this is a good opportunity for Europe to revert the current situation in which Europe is totally dependent from other countries for the supply of batteries.

Finally, and with an eye fixed on a distant future, the analysis performed by Tidblad et al. [4], entitled *Future Material Developments for Electric Vehicle Battery Cells Answering Growing Demands from an End-User Perspective*, indicates which materials, based on current data, are the ones to investigate for the different parts involved in the battery (i.e., anode, cathode, electrolyte) considering both performance and safety issues.

Although not having many articles, this Special Issue in *Energies* looks at the present and future of high-capacity cells and batteries for electric vehicles, and provides a good picture of what we have and what we will have in our hands.

Enjoy the reading!

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References

1. Geisbauer, C.; Wöhrl, K.; Koch, D.; Wilhelm, G.; Schneider, G.; Schweiger, H.G. Comparative Study on the Calendar Aging Behavior of Six Different Lithium—Ion Cell Chemistries in Terms of Parameter Variation. *Energies* **2021**, *14*, 3358. [CrossRef]
2. Wöhrl, K.; Geisbauer, C.; Nebl, C.; Lott, S.; Schweiger, H.-G. Crashed Electric Vehicle Handling and Recommendations—State of the Art in Germany. *Energies* **2021**, *14*, 1040. [CrossRef]
3. Kotak, Y.; Marchante Fernández, C.; Canals Casals, L.; Kotak, B.S.; Koch, D.; Geisbauer, C.; Trilla, L.; Gómez-Núñez, A.; Schweiger, H.-G. End of Electric Vehicle Batteries: Reuse vs. Recycle. *Energies* **2021**, *14*, 2217. [CrossRef]
4. Tidblad, A.A.; Edström, K.; Hernández, G.; de Meatza, I.; Landa-Medrano, I.; Jacas Biendicho, J.; Trilla, L.; Buysse, M.; Ierides, M.; Horno, B.P.; et al. Future material developments for electric vehicle battery cells answering growing demands from an end-user perspective. *Energies* **2021**, *14*, 4223. [CrossRef]