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Guest Editorial

Special Section on Advances in Lithium-Ion Battery Safety

Battery safety has attracted attention worldwide due to the exponentially increasing numbers of mobile devices and as well as the fast-growing electric vehicle market. The milestone safety issues, i.e., short circuit and thermal runaway, can be triggered by mechanical, electrical, and thermal abusive loadings. Such catastrophic events are highly nonlinear and strongly multiphysics-coupled problems, which hinders a clear understanding of the mechanism and direct guidance for engineering applications. Further, safety problems can evolve and exhibit in various ways spanning various scales, i.e., from the active particle level (1 μm) up to the battery pack level (1 m). Research on lithium-ion battery safety may lead to breakthroughs in electrochemistry and multiphysics theories, offer rational engineering designs, and develop advanced battery management systems.

In light of these challenges and urgent industry needs, Prof. Jun Xu and Dr. Yangxing Li initiated the Automotive and Battery Safety Conference (ABSC) in early 2018, which is dedicated to the discussion of battery safety issues. The participants at ABSC are from renowned universities, research institutes, and leading companies worldwide. Some new ideas were initiated from the ABSC 2021, held virtually on September 27–29, 2021. Thus, we open this Special Section issue to record these new ideas.

This Special Section issue, which comprises selected publications from the participants of ABSC 2021, is envisioned to present numerical computation models, security strategy, and state monitoring to address LIB safety issues. To analyze the mechanical properties of LIB cells, Chen et al. carried out a comprehensive experimental investigation on the mechanical integrity of the large-capacity pouch LIBs, considering various loading scenarios, speeds, and SOCs. A finite element model was also established accordingly to study the safety behavior of the batteries. From the multiphysics perspective, Li et al. proposed a practical workflow based on multiphysics computational techniques which could describe the mechanical failure, internal short circuit, and thermal runaway behaviors of pouch LIB cells under steel ball compression. In particular, Huang et al. focused on the thermal runaway behaviors of LIBs. They investigated the influence of heat dissipation flow on the thermal runaway through combining simulation and experiment and obtained the relationship between the TR temperature and minimum heat dissipation flow. Safety management of the LIB cell and its pack is also one of the hot topics in this Special Section issue. Garg et al. presented a holistic engineering design and simulation strategy for a future advanced battery pack by assimilating paradigmatic solutions for cell material selection, component design, cell clustering, thermal management, battery monitoring, and recycling aspects of the battery and its components. Li et al. reported a fluidized bed coating method on the cathode that slows down the reaction between solid electrolyte and the cathode active material, thus enhancing the cycling performance of all-solid-state batteries. On the other hand, several papers in this issue focus on how to correctly estimate the different state parameters such as Capacity, state of health (SOH), and state of charge (SOC) of the LIBs. For example, Li et al. proposed a Convolutional Neural Network-Long Short Term Memory-based deep learning to estimate the discharge capacity of LIBs. Peng et al. proposed a new fusion method for inaccurate prediction of lithium-ion battery SOH. Furthermore, an online method based on indirect health features and a sparrow search algorithm fused with a deep extreme learning machine to estimate the SOH of LIBs is established by Zhang et al. At the same time, Chang et al. reported a new methodology to estimate the SOH of LIBs based on electrochemical impedance spectroscopy with the neural network. For SOC estimation, Yu et al. proposed a novel trigger for parameter filter based on open-loop voltage to improve the accuracy of SOC estimation. Yu et al. proposed a novel heat generation acquisition method of the cylindrical battery based on core and surface temperature measurements during charging/discharging of the LIBs. Besides, Gao et al. review the different design strategies of flame-retardant additives in LIBs electrolytes.

We would like to thank all contributors to this Special Section issue for submitting the latest high-impact work addressing the safety of LIBs. Also, we give our special thanks to the invited reviewers for helping us further enhance the quality of the articles. Finally, we express our warm gratitude to Prof. Wilson Chiu, the Editor-in-Chief of the ASME *Journal of Electrochemical Energy Conversion and Storage*, for his continuous encouragement and support.

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