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Multilayer Zwitterionic Materials in Lithium-ion Batteries

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Abstract:

Our team has investigated the integration of electrospinning technology with zwitterion structures in the fabrication of high-performance polymeric electrolytes for lithium-ion battery applications. Multilayer polymer membranes were first synthesized via electrospinning, enabling the optimization of both the microstructural features and macroscopic performance. The membranes demonstrated superior mechanical strength, electrical insulation properties, and safety, showing the significant potential of electrospinning as a versatile method for producing genuine separators.

Further, the potential of zwitterion systems in enhancing the ionic conductivity and stability was explored. The zwitterion configuration, characterized by its unique ionic interactions, effectively improves the ion transport properties and electrochemical stability of the electrolyte. The incorporation of zwitterions into solid-state electrolytes led to substantial improvements in lithium-ion conductivity and cycling stability. It exhibited enhanced mechanical robustness, interface stability, and long-term electrochemical performance, thus contributing to the overall performance of the electrolyte in lithium battery systems. Finally, the multilayer zwitterionic membranes were further surface-modified to gel electrolytes, where specialized surface treatments were employed to significantly enhance their ionic conductivity and cycling stability at ambient temperatures. This surface treatment approach also strengthened the structural integrity and interfacial compatibility of the gel electrolytes, further enhancing the safety and performance of the lithium-ion batteries.

We demonstrate the substantial potential of combining electrospinning and zwitterion systems in the development of advanced lithium battery electrolytes. The findings offer a promising pathway for the design of high-performance, durable battery materials, with significant implications for the next generation of energy storage technologies, particularly in the development of electrolytes that exhibit exceptional performance at room temperature.

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Biography:

Dr. Lo received her B.S. and M.S. degrees from Chang Gung University in 2011, and obtained her PhD degree in Chemical Engineering from National Taiwan University in 2016. She then joined Yamagata University (Japan) as an assistant professor in both the Innovative Flex Course for Frontier Organic Material Systems (iFront) and the Department of Organic Materials Science. After that, she was a faculty at Chung Yuan Christian University and then National Sun Yat-Sen University from 2018 to 2022, and has been a member of R&D Center of Membrane Technology in Chung Yuan Christian University since 2018. She is currently an assistant professor in the Department of Materials Science and Engineering in National Taiwan University of Science and Technology. Her current research interests include the design and synthesis of advanced polymers, organic optoelectronic devices, and polymers for lithium-ion batteries.
https://sites.google.com/view/aolab/home

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