State-of-the-art review on electrolytes for sodium-ion batteries: Potential recent progress and technical challenges

Navid Aslfattahi [a *], L. Samylingam [b], Maryam Sadat Kiai [c], **K. Kadirgama** [d e *], Vladimir Kulish [a], Michal Schmirler [a], Zafar Said [f g h]

[a] Department of Fluid Mechanics and Thermodynamics, Faculty of Mechanical Engineering, Czech Technical University in Prague, Technická 4, 166 07 Prague, Czech Republic

[b] Advanced Nano Coolant-Lubricant (ANCL) Lab, Automotive Engineering Centre, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

[c] Center for BioNano Interactions, School of Chemistry, University College of Dublin, Belfield, Dublin 4, Ireland

[d] Faculty of Mechanical & Automotive Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

[e] Almaaqal University, College of Engineering, Department of Civil Engineering, Basra 61003, Iraq

[f] Department of Sustainable and Renewable Energy Engineering, University of Sharjah, 27272 Sharjah, United Arab Emirates

[g] U.S.-Pakistan Center for Advanced Studies in Energy (USPCAS-E), National University of Sciences and Technology (NUST), Islamabad, Pakistan

[h] Department of Industrial and Mechanical Engineering, Lebanese American University (LAU), Byblos, Lebanon

ABSTRACT

Lithium batteries play a prominent role as a critical technology for advancing electric vehicles. However, establishing lithium-based technologies for mass storage encounters critical challenges such as materials availability and cost-efficiency. Hence, strategic approaches should be developed to address the existent challenges. Using sodium as new sustainable chemistry to replace lithium-based technologies tends to exhibit promising solution as the most appealing alternative. While exploring new electrode materials which has attracted significant interest from eminent researchers for sodium-ion batteries, research activities related to electrolyte are less attention paid. This paper reviews the most recent articles on developing and improving the electrolytes for sodium-ion batteries, particularly liquid electrolytes. This is the latest comprehensive discussion related to sodium-ion batteries with different type of electrolytes and a particular focus on the advantages/disadvantages in order to improve efficiency of these novel technologies as well as comprehensive discussion on the application of advanced nanomaterials towards these devices.

KEYWORDS

Sodium-ion battery; Aqueous electrolyte; Organic electrolyte; Solid-state electrolyte

ACKNOWLEDGEMENTS

The authors would like to thanks Universiti Malaysia Pahang for providing grant under No. RDU213308. The Department of Fluid Mechanics and Thermodynamics of the Faculty of Mechanical Engineering at Czech Technical University in Prague is gratefully acknowledged by the authors for its support.