IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, June 2023

Investigation of Solid-State Batteries for Safer and More Efficient Energy Storage

Jordan Y. Arpilleda

Faculty, Department of Industrial Technology,

North Eastern Mindanao State University - Cantilan Campus, Cantilan, Surigao del Sur, Philippines

Abstract: *This research conducts an in-depth quantitative analysis involving 30 participants to optimize solid-state battery electrodes for high-power energy storage applications. The study investigates the intricate relationship between diverse electrode materials and crucial performance metrics, including energy storage capacity, rate capability, and cyclic stability. The findings highlight the pivotal influence of material attributes on electrode behavior, with strong evidence of a positive correlation between conductivity and energy storage capacity. Moreover, the study confirms that smaller particle sizes enhance rate capability, underscoring the significance of material morphology for swift energy exchange. Notably, surface-modified electrodes exhibit enhanced cyclic stability, showcasing the potential of interface engineering for improved long-term performance. The empirical insights gained from this investigation offer valuable guidance for informed material selection and electrode design strategies, not only benefiting high-power energy storage applications but also contributing to broader energy storage technologies. The research outcomes contribute to the advancement of energy storage systems by refining electrode materials and designs, fostering efficiency, sustainability, and technological progress.*

Keywords: solid-state batteries, electrode optimization, high-power energy storage, quantitative analysis

REFERENCES

[1]. Zhang, A., Yin, Z., Wu, Z., Xie, M., Liu, Y., & Yu, H. (2023). Investigation of the compressed air energy storage (CAES) system utilizing systems-theoretic process analysis (STPA) towards safe and sustainable energy supply. *Renewable Energy*, *206*, 1075-1085.

[2]. Bulut, M., & ÖZCAN, E. (2021). Integration of battery energy storage systems into natural gas combined cycle power plants in fuzzy environment. *Journal of Energy Storage*, *36*, 102376.

[3]. Liu, X., Zhao, F., Hao, H., & Liu, Z. (2023). Opportunities, Challenges and Strategies for Developing Electric Vehicle Energy Storage Systems under the Carbon Neutrality Goal. *World Electric Vehicle Journal*, *14*(7), 170.

[4]. Gu, F., & Ma, X. (2022). Stimuli-Responsive Polymers with Room-Temperature Phosphorescence. *Chemistry–A European Journal*, *28*(15), e202104131.

[5]. Rofeal, M., Abd El-Malek, F., & Qi, X. (2021). In vitro assessment of green polyhydroxybutyrate/chitosan blend loaded with kaempferol nanocrystals as a potential dressing for infected wounds. *Nanotechnology*, *32*(37), 375102.

[6]. Yu, N., Morris, C. E., Joós, B., &Longtin, A. (2012). Spontaneous excitation patterns computed for axons with injury-like impairments of sodium channels and Na/K pumps.

[7]. Ashby, M. F., & CEBON, D. (1993). Materials selection in mechanical design. *Le Journal de Physique IV*, *3*(C7), C7-1.

[8]. Evans, A. G., Hutchinson, J. W., Fleck, N. A., Ashby, M. F., & Wadley, H. N. G. (2001). The topological design of multifunctional cellular metals. *Progress in materials science*, *46*(3-4), 309-327.

[9]. Molaei, R., Fatemi, A., Sanaei, N., Pegues, J., Shamsaei, N., Shao, S., ... & Phan, N. (2020). Fatigue of additive manufactured Ti-6Al-4V, Part II: The relationship between microstructure, material cyclic properties, and component performance. *International Journal of Fatigue*, *132*, 105363.

[10]. Bachheti, R. K., Konwarh, R., Gupta, V., Husen, A., & Joshi, A. (2019). Green synthesis of iron oxide nanoparticles: cutting edge technology and multifaceted applications. *Nanomaterials and plant potential*, 239-259.

[11]. Sofiah, A. G. N., Pasupuleti, J., Samykano, M., Kadirgama, K., Koh, S. P., Tiong, S. K., ... & Natarajan, S. K. (2023). Harnessing Nature's Ingenuity: A Comprehensive Exploration of Nanocellulose from Production to Cutting-Edge Applications in Engineering and Sciences.

[12]. Kim, J. G., Son, B., Mukherjee, S., Schuppert, N., Bates, A., Kwon, O., ... & Park, S. (2015). A review of lithium and non-lithium based solid state batteries. *Journal of Power Sources*, *282*, 299-322.

[13]. Heubner, C., Maletti, S., Auer, H., Hüttl, J., Voigt, K., Lohrberg, O., ... &Michaelis, A. (2021). From lithium-metal toward anode-free solid-state batteries: current developments, issues, and challenges. *Advanced Functional Materials*, *31*(51), 2106608.

[14]. Wu, J., Liu, S., Han, F., Yao, X., & Wang, C. (2021). Lithium/sulfide all-solid-state batteries using sulfide electrolytes. *Advanced Materials*, *33*(6), 2000751.

[15]. Heiska, J., Nisula, M., &Karppinen, M. (2019). Organic electrode materials with solid-state battery technology. *Journal of Materials Chemistry A*, *7*(32), 18735-18758.

[16]. Thenuwara, A. C., Shetty, P. P., Kondekar, N., Sandoval, S. E., Cavallaro, K., May, R., ... & McDowell, M. T. (2020). Efficient low-temperature cycling of lithium metal anodes by tailoring the solid-electrolyte interphase. *ACS Energy Letters*, *5*(7), 2411-2420.

[17]. Alipoori, S., Mazinani, S., Aboutalebi, S. H., & Sharif, F. (2020). Review of PVA-based gel polymer electrolytes in flexible solid-state supercapacitors: Opportunities and challenges. *journal of energy storage*, *27*, 101072.

[18]. Minnmann, P., Quillman, L., Burkhardt, S., Richter, F. H., &Janek, J. (2021). Editors' choice—quantifying the impact of charge transport bottlenecks in composite cathodes of all-solid-state batteries. *Journal of The Electrochemical Society*, *168*(4), 040537.

[19]. Li, L., Liu, W., Dong, H., Gui, Q., Hu, Z., Li, Y., & Liu, J. (2021). Surface and interface engineering of nanoarrays toward advanced electrodes and electrochemical energy storage devices. *Advanced Materials*, *33*(13), 2004959.

[20]. Xia, Q., Zan, F., Zhang, Q., Liu, W., Li, Q., He, Y., ... & Xia, H. (2023). All-Solid-State Thin Film Lithium/Lithium-Ion Microbatteries for Powering the Internet of Things. *Advanced Materials*, *35*(2), 2200538.

[21]. Pang, Y., Cao, Y., Chu, Y., Liu, M., Snyder, K., MacKenzie, D., & Cao, C. (2020). Additive manufacturing of batteries. *Advanced Functional Materials*, *30*(1), 1906244.