**Comparison and Perspective of Sodium Ion and Lithium Ion Battery**

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| **Abstract** In recent years, the demand for lithium has surged, and limited global lithium reserves have caused the price of lithium compounds to rise significantly. Sodium (Na), one of the most abundant elements on Earth, offers a viable alternative [1]. Sodium’s natural abundance in the Earth’s crust is 2.8%, making sodium carbonate (Na₂CO₃) resources significantly cheaper compared to lithium carbonate (Li₂CO₃) [1], [2]. Sodium-ion batteries (SIBs) have the potential to fill this gap as a sustainable alternative to existing battery technologies. When examining the abundance of transition metals, lithium (Li) and cobalt (Co) stand out as two of the least abundant, with concentrations in the Earth’s crust at 20 ppm and 25 ppm, respectively. In contrast, nickel (Ni) is relatively abundant, available at 84 ppm [2]. Additionally, there are a variety of commercially available sodium-based sources that support electrode labeling. Sodium-ion batteries (SIBs) and lithium-ion batteries (LIBs) operate on similar principles. However, Na has a larger atomic and ionic radius than Li; Na⁺ ions are 0.26 Å larger than Li⁺ ions. This size difference can lead to variations in the formation of solid electrolyte interfaces (SEIs), affecting the portability, phase stability, and elasticity of SIBs [1]. In addition to differences in electrode materials, another notable variation between LIBs and SIBs is the choice of current collectors. In LIBs, aluminum (Al) foil is typically used as the current collector for the cathode, while copper (Cu) foil is used for the anode. This is because lithium forms an alloy with aluminum at lower potential, which could lead to performance issues. Between the electrodes, a porous separator with electrolyte solution is placed to prevent short circuits [2], [3]. SIBs adopt a similar architecture, but with a key difference: aluminum foil can be used as the current collector for both the anode and cathode, as sodium does not form an alloy with aluminum at lower potentials. This substitution of lithium with sodium and copper with aluminum could reduce the cost of SIBs; however, it would increase the overall mass and volume of the battery system compared to LIBs. Achieving cost-effectiveness in terms of $/kWh is critical for the commercial viability of battery technologies, especially in applications targeted toward end users [2]. Energy density of a SIB is mostly lower than LIB [4]. Generally speaking, the use of sodium, which has a low price, high availability and relatively low energy density, may increase in the coming years. Especially with the spread of electric vehicles, limited lithium resources and inefficient recycling processes, finding an alternative to lithium is a necessity.**References:** [1] Balci, E., Altundağ, S., & Altın, S. (2024). Sodyum-iyon Bataryaların Yapısı ve Elektrokimyasal Mekanizmaları. *Türk Mühendislik Araştırma ve Eğitimi Dergisi*, *3*(1), 58-71. [2] Pahari, D., Verma, P., & Puravankara, S. (2022). Are Na-ion batteries nearing the energy storage tipping point?–Current status of non-aqueous, aqueous, and solid-sate Na-ion battery technologies for sustainable energy storage. *Journal of Energy Storage*, *56*, 105961.[3] Myung, S. T., & Yashiro, H. (2014). Electrochemical stability of aluminum current collector in alkyl carbonate electrolytes containing lithium bis (pentafluoroethylsulfonyl) imide for lithium-ion batteries. *Journal of Power Sources*, *271*, 167-173.[4] Kubota, K., Dahbi, M., Hosaka, T., Kumakura, S., & Komaba, S. (2018). Towards K‐ion and Na‐ion batteries as “beyond Li‐ion”. *The chemical record*, *18*(4), 459-479. |
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