Exploring promising materials platforms for potassium batteries

Lucia Fagiolari, Daniele Versaci, Federica Di Berardino, Matteo Gandolfo, Julia Amici, Carlotta Francia, Silvia Bodoardo, Federico Bella

Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 - Torino, Italy
E-mail: lucia.fagiolari@polito.it

Future renewable energy integrated grid systems require rechargeable batteries with low cost, high safety and long cycle life. The much higher abundance of potassium compared to lithium in Earth crust indicates that rechargeable potassium batteries can represent an attractive replacement for lithium-ion counterparts. Rechargeable potassium batteries have gained tremendous attention during the past decade [1,2]. However, the development of rechargeable potassium batteries is still in its infancy.
Due to the large atomic radius of potassium, some electrode materials that are commonly used in Li-ion systems are not suitable for potassium batteries. Thus, anode materials for these energy storage systems are mainly based on carbon materials, metal alloys and potassium metal. On the other hand, cathode materials can be divided into three categories: Prussian blue and its analogues, layered metal oxides and polyanion oxides. Electrolytes able to guaranteeing efficient K^+ transport and long-term stability are currently under investigation.
In this emerging field, the main challenges are: i) achieving a strong structural stability of newly developed electrodes; ii) inhibit the formation of potassium dendrites and build a stable electrode/electrolyte interface; iii) trying to find an electrode to be considered as a reference/standard system when evaluating the performance of newly synthesized compounds for anodes and cathodes; iv) investigate polymer membranes to achieve solid-state K-based batteries. In this contribution, an overview of these topics under study at the Electrochemistry Group @PoliTO is presented, figuring out the most promising strategies to design lab-scale working devices.

References

1. W. Zhang et al., *Nano Energy* **2021**, *83*, 105792.
2. Y. Liu et al., *Small* **2020**, *16*, 2004096.