MS025.O02

Enhanced energy density in oxides and alluaudites battery materials

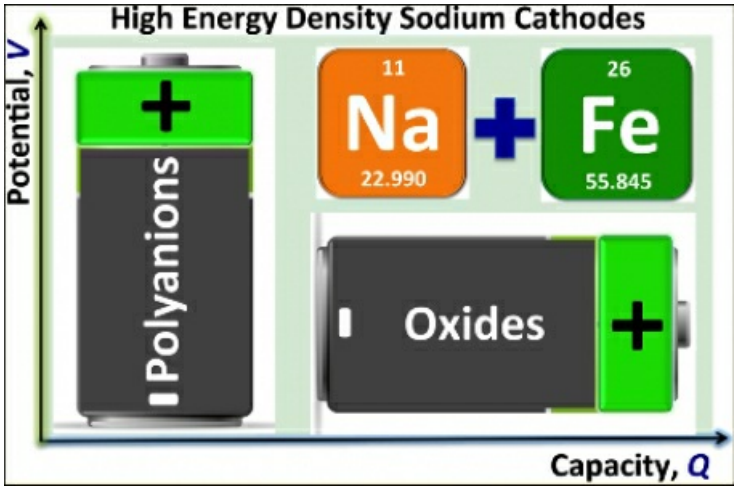
Prabeer Barpanda[1]
[1]*Indian Institute Of Science, Bangalore, India*
E-mail: prabeer@mrc.iisc.ernet.in

Electrochemical energy-storage devices such as rechargeable batteries continue to experience ever-growing applications ranging from small-scale consumer electronics to large-scale grid storage. These batteries can be tailored according to the final applications. While Li-ion batteries serve applications warranting high-volumetric/ gravimetric energy density, Na-ion batteries can cater large-scale usages independent of energy density at an economic cost. Various oxides and polyanionic framework compounds have been discovered, optimized and engineered to make room-temperature sodium batteries viable.

Similar to the story of Li-ion batteries, sodium-ion batteries too can be improved by employing structural/ chemical approaches to maximize their energy density. It can be accomplished in two ways: (i) increasing the reversible capacity and/ or (ii) enhancing the redox operation potential. While the first approach is used in various oxide (NaxTMO2) materials, the later is exploited in polyanionic framework materials. Sodium-ion batteries are catching attention owing to their elemental abundance and thereby low cost. In this scenario, developing cathode chemistry with earth-abundant Fe transition metal can be very cost effective.

The current work will describe the discovery and development of two champion Fe-based materials showing the highest energy density among all known sodium insertion systems. While the P2-layered structured sodium iron oxide delivers the highest reversible capacity close to 200 mAh/g, the monoclinic alluaudite structured sodium iron sulfate exhibits the highest Fe3+/Fe2+ redox activity. The crystal structure, polymorphism, structural transition during desodiation reaction and its effect on final electrochemical performance will be described.

[1] Barpanda, P. et al. (2014). Nature Commun. 5, 4358.
[2] Yabuuchi, N. et al. (2012). Nat. Mater. 11, 512-517.
[3] Barpanda, P. (2015) Isr. J. Chem. 55, 537-557.
[4] Barpanda, P. (2016). Chem. Mater. 28, 1006-1011.



Keywords: sodium batteries, oxides, alluaudites