New layer- and tunnel- Structured Materials for Sodium-Ion Batteries

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Rechargeable sodium ion batteries (SIBs) are now attracting special attention with a great cost advantage over rechargeable lithium ion batteries (LIBs) especially in the field of the large-scale applications. For the successful development of the SIBs, it is imperative to find new cathode and anode materials with high capacity, high power and long cycle life. With this perspective, we have examined the electrochemical properties of O3-layer structured oxides, $Na_3M(II)_2M(V)O_6$, with a honeycomb ordering of M(II) and M(V) in the metal layer for the cathode material in SIBs.[1] One of this class materials, $Na_3Ni_2BiO_6$, is able to reversibly deliver specific discharge capacities of up to 109 mAh/g with very flat voltage plateaus ~3.5V vs. Na/Na+. Structural changes occurring during charging/discharging investigated by using in situ X-ray diffraction (XRD) are correlated with its long cycle life. Long and short-range structure changes at various state of (dis)charge have been also probed ex-situ using combined synchrotron-based high-resolution X-ray powder diffraction (HRPD) and extended X-ray absorption fine structure (EXAFS). Some of its derivatives with increased redox voltages will also be presented. For the anode materials, various compositions of transition metal oxides including Ti, Fe and Sn elements having tunnel based structures (single- and double- tunnels) are explored as rechargeable SIBs.[2] Detailed electrochemical results combined with structural characterization will be presented in the meeting.

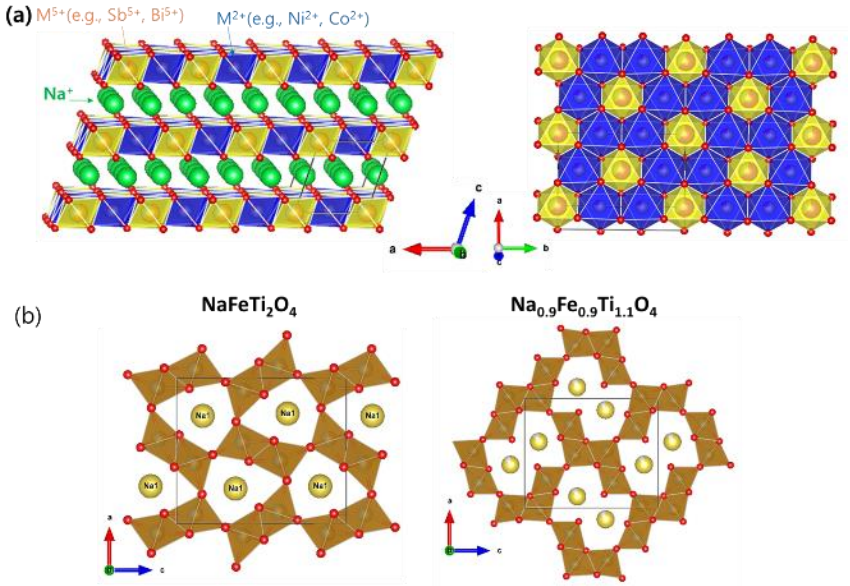

Figure. Crystal structure of (a) honeycomb-layer structured $Na_3M(II)_2M(V)O_6$ cathode and (b) tunnel-structured $Na_xFe_xTi_{2-x}O_4$ anode

References:

[1] D.S. Bhange, G. Ali, D.-H. Kim, D.A. Anang, T.J. Shin, M.G. Kim, Y.-M. Kang, K.Y. Chung, K.-W. Nam, J. Mat. Chem. A 5 (2017) 1300-1310.
[2] D.S. Bhange, G. Ali, J.-Y. Kim, K. Y. Chung, K.-W. Nam, J. Power Sources 366 (2017) 115-122.