INSIGHT INTO ELECTROCHEMICAL ACTIVITIES OF Na-ION HOST MATERIALS

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Li-ion secondary battery has been investigated as one of the best energy storage systems due to its high energy density and electrochemical reversibility for the last few decades even their cost and resource restrictions are prohibitive for large-scale applications. This is why a great deal of attention has been devoted recently to the development of lower cost and more abundant alternative chemistries such as Na-ion battery.

Intensive researches on a number of potentially economical Na-containing host materials as substitutes for relatively expensive $LiCoO_2$ such as $Na_2MP_2O_7$, Na_2MnSiO_4, and $NaMO_2$ [1, 2, 3] have been widely carried out, which are not still yet able to meet the industrial needs. This issue stems from the existence of large alkali ion, sodium, in the structure and thus sometimes resulting in structural instability or electrochemical inactivity. Therefore, current Na-containing host materials designed from their famous Li-equivalents need to be carefully reinvestigated and compared with other host materials to meet the industrial needs.

Our approaches were two-fold: to utilize the ionic/electrical conductivity properties of the title compounds through investigating the corresponding doping effects and structural evolutions using various analysis techniques: ii) to provide the preliminary structural and electrochemical information about new Na-ion cathode candidate materials based on their well-known Li-equivalents.

In this presentation, we will briefly introduce our current research progresses in new Na-containing cathode materials, $NaVP_2O_7$, Na_2FeSiO_4, and $Na_3Ni_2SbO_6$, and provide preliminary ideas about their electrochemical (in)activities using various analytic techniques including ex-situ XRD, FTIR, EIS, and galvanostatic charge/discharge [4, 5, 6]. In addition, their possible structural evolutions upon desodiation are predicted by DFT calculations and will be introduced.

References
[1] J. M. Clark, P. Barpanda, A. Yamada, and M.S. Islam, *J. Mater. Chem. A* **2** (2014) 11807.
[2] J. Zhao, L. Zhao, N. Dimov, S. Okada, and T. Nishida, *J. Electrochem. Soc.* **160** (2013) A3077.
[3] C. Chen, K. Matsumoto, T. Nohira, and R. Hagiwara, *Electrochem. Comm.*, **45** (2014) 63.
[4] Y. Kee, N. Dimov, A. Staikov, P. Barpanda, Y. Lu, K. Minami, and S. Okada, *RSC Adv.* **5** (2015) 64991.
[5] Y. Kee, N. Dimov, A. Staykov, and S. Okada, *Mater. Chem. Phys.* **171** (2016) 45.
[6] Y. Kee, N. Dimov, A. Staykov, and S. Okada (2016). *Atomistic insight into Mg-doping effects on $Na_3Ni_2SbO_6$ cathode host for Na-ion batteries.* Manuscript submitted for publication.

□Profile□

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Research interests

- Non-carbonaceous inorganic electrode materials for Li-ion all-solid-state and aqueous battery
- Synthesis and characterization of novel Na-ion cathode materials for Na-ion battery
- Inter-relationship between structural evolutions upon M-doping and electronic properties

Education

2006-2011	B.Sc. in Chemistry
2011-2013	M.Sc. in Solid State Chemistry (Ajou University, Korea)
2013-2016 (expected)	D3 in Engineering Science (supervisor: Shigeto Okada)

Honours

2012/02	Poster Presentation Award at AJOU-KIT-KYOTO symposium (Kyoto, Japan)
2015/02	MRSI prize for the Best Poster Paper (Jaipur, India)

Teaching and researching experiences

2011/03-2012/12	Teaching Assistant, Ajou University (Korea)
2015/05-2015/08	Visiting student, University of Glasgow (UK)