Center for Molecular Spectroscopy and Dynamics, IBS-Korea University

IBS Center for Molecular Spectroscopy and Dynamics

Seminar

- **SPEAKER**
  Prof. Hye Ryung Byon (KAIST)

- **TITLE**
  Understanding Interfacial Reaction of LiCoO2 Positive Electrode in Aqueous Lithium-Ion Batteries

- **ABSTRACT**
  Since the risk of catch fire using non-aqueous electrolyte solution, aqueous solution-based rechargeable lithium batteries (ARLB) have been highlighted. However, the conventional positive electrodes of lithium transition-metal oxide such as LiCoO2 (LCO) and LiNi1/3Mn1/3Co1/3O2 (NMC) have suffered from poor cyclability in aqueous medium. Representatively, the layered two-dimensional structure of LCO shows notably poor stability, possibly due to the surface degradation from water [1] and proton [2]. However, understanding of interfacial reaction of LCO in the aqueous electrolyte solution is still superficial. Here we present degradation phenomena of LCO electrode in aqueous medium using various X-ray measurement techniques, and suggest the solution to avoid such an irreversible electrochemical reaction. The aqueous solution was prepared with 0.5 M lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) and pH was controlled to ~6.8 and 10. In both cases, there was no evidence for the formation of cathode-electrolyte interphase (CEI) on LCO in contrast to the one with non-aqueous electrolyte solution. The direct contact of aqueous electrolyte solution to LCO surface results in the short-range disorder of LCO structure such as the distortion of octahedral CoO6, and irreversible Li+ desertion during 10 cycles. To improve electrochemical reversibility and structural stability of LCO, we prepared the organic protection layer that opened the Li+ mass transport route while inhibiting H2O contact from hydrophobic surface. As a result, the capacity retention was improved to ~85% during 30 cycles at pH ~ 6.8. Furthermore, we developed the way to protect LCO surface by anion engineering and in the absence of protection layer, which give insight into the inner Helmholtz plane (IHP) structure and its effect for LCO degradation in aqueous medium.

- **DATE AND VENUE**
  November 14, 2019 (Thursday, 4:00 - 5:00)
  Seminar Room A (116), KU R&D Center

- **INVITED BY**
  Professor Kyungwon Kwak

- **LANGUAGE**
  Korean