**황화물 기반 전고체 전지용 소재 및 셀 연구 개발 동향  
Development on materials and cells   
for sulfide based all solid state batteries**

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**Abstract**

With declaration of carbon zero in response to climate change to solve global warming, large-scale energy storage devices for electric vehicles have actively developed. Although commercialized electric vehicle adopted with a state-of-the-art lithium ion batteries (LIB) could drive over 300 miles by one single charge, there are still explosion and flammability issues of liquid based electrolyte. All-solid-state batteries (ASSBs) using solid electrolyte (SE) is one of alternative systems, and sulfide based SE could be comparable to liquid electrolyte level in terms of ionic conductivity. Among the various sulfide-based SE, Li6PS5Cl (LPSCl) have been considered as promising SE because of its high ionic conductivity (3x10-3 S cm-1) at room temperature [1].

Pellet-type coin cell that consisted with LiNi0.5Co0.2Mn0.3O2 (NCM523)|LPSCl|In showed the initial specific capacity 140 mAh g-1. However, there is a significant decrease in capacity, and the capacity retention have below 50% within 50 cycles. There were several investigation reports in the point of view for inferior cell performance. Janek’s group reported about interface behavior at the cathode. They asserted that contact loss between active materials and SE occurred by chemomechanical contraction of active material and by decomposition of SE resulting in increasing interface resistance [2]. In addition, the side reaction of carbon-containing cathode composite which accelerates the oxidation of sulfide-based SE on cathode surfaces [3]. Here in this study, we investigated deterioration factors that originated from not only electrolyte decomposition at composite cathode but also cathode structural deterioration. In particular, XRD analysis revealed that phase transition analysis from layered R(-)3m phase to the spinel phase Fd(-)3m especially interface between cathode and electrolyte, and this result could be supported by TEM. We will discuss further more in detail what the reason is to occur capacity degradation with above and additional analysis tool.

**Reference**

[1] C. Yu et al., *Electrochimica Acta* **2016**, 215, 93–99.

[2] R. Koerver et al., *Chem. Mater.* **2017**, 29, 5574-5582.

[3] W. Zhang et al., *ACS Appl. Mater. Interfaces* **2017**, 9, 35888−35896.