

# Composite cathode prepared from argyrodite-type $\text{Li}_6\text{PS}_5\text{Cl}$ precursor solution containing dispersant agents for all-solid-state battery

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Sulfide-based solid electrolytes (SSE) have been used to fabricate all-solid-state lithium batteries (ASLBs). Recently, solution process has been evaluated to produce lower interfacial electrode/electrolyte resistance because a SSE liquid phase can cover effectively the solids particles of active material. The formation of adequate interface has been verified by the good electrochemical performance of the bulk-type ASLBs (15 wt% SSE) achieving initial discharge capacities of ca.  $120 \text{ mA h g}^{-1}$  [1,2]. The effort to reduce the amount of SSE- layer, to increase the energy density, lead to a drop of the discharge capacity (ca.  $50 \text{ mA h g}^{-1}$ ) [3,4].

Here, composite cathode with a high content of active material ca. 90 wt% ( $\text{LiNi}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{O}_2$ , NMC) was prepared by its dispersion into an argyrodite-type  $\text{Li}_6\text{PS}_5\text{Cl}$  precursor solution containing dispersant agents and carbon additive. Solvents were removal by heating at  $180^\circ\text{C}$  under vacuum for 3 h.

Fig 1a. shows SEM micrograph of  $\text{Li}_6\text{PS}_5\text{Cl}$  obtained by solution process containing dispersant, small/regular particles size at nanometric scale were obtained ( $\sigma = 0.3 - 1 \times 10^{-3} \text{ S cm}^{-1}$ ). Fig 1b. displays first cycle performance of ASSBs cell fabricated with composite electrode (89 wt% NMC, 9 wt% SSE) derived from solution process. High initial discharge capacity of  $110 \text{ mA h g}^{-1}$  at  $25^\circ\text{C}$  with a capacity retention of 97% after 10 cycles was obtained from the composite cathode derived from solution process containing dispersant, better that those without dispersant ( $40 \text{ mA h g}^{-1}$ ). The results indicate that favourable SSE-layer can be controlled by chemical way through strategic selection of protic/aprotic solvent and dispersants.

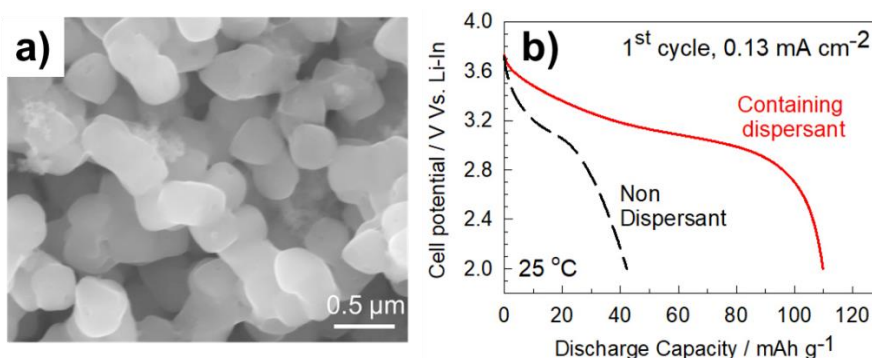


Figure 1. a) SEM micrograph of  $\text{Li}_6\text{PS}_5\text{Cl}$  obtained from solution process and b) 1<sup>st</sup> discharge curve of ASLB cell fabricated with composite cathodes derived from solution process

## References:

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**Acknowledgment.** The present study is supported by JST ALCA-SPRING project.