Department of Materials Science and Engineering Seminar Series 2025

NaSICON Materials for Advanced Na Solid State Batteries

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Date and time: 22 April 2025, 9.15am – 11.15am

Venue: EA-02-15

Abstract

To achieve net zero carbon emission, developing and optimizing rechargeable batteries have become crucial criteria to enable safe and reliable energy storage systems. Commercial lithium-ion batteries typically use a nonaqueous, flammable liquid electrolyte, posing a safety hazard in thermal runaways. Replacing the liquid electrolyte with Natrium SuperIonic CONductor (NaSICON) solid electrolyte enhances the overall safety of the battery. At the same time, the transition from lithium to sodium reduces environmental pollution from mining due to the higher availability of sodium. Using computation and experiments, we reconciled discrepancies of the total ionic conductivity values of NaSICON $Na_{1+x}Zr_2Si_xP_{3-x}O_{12}$, $0 \leq x \leq 3$, in the literature, with $Na_{3.4}Zr_2Si_{2.4}P_{0.6}O_{12}$ having the highest total ionic conductivity due to a high silicon content and optimal sodium-to-vacancy ratio. The synthesis of $Na_{3.4}Zr_2Si_{2.4}P_{0.6}O_{12}$ was optimized by lowering the amount of zirconium precursors to obtain NaSICON free of *m*-ZrO_2. We further increase the total ionic conductivity by doping $Na_{3.4}Zr_2Si_{2.4}P_{0.6}O_{12}$ with tantalum/niobium while keeping optimal sodium content. The electrochemical performance of $Na_{3.4}Zr_2Si_{2.4}P_{0.6}O_{12}$ was also probed in two monolithic sodium-ion and one sodium metal all-solid-state batteries. These findings contribute to understanding NaSICON solid electrolytes to enable high-performing sodium all-solid-state batteries for functional applications.

Biography

Aaron Tieu Jue Kang received his B.Sc (Hons) in Chemistry from National University of Singapore in 2018. He is currently a PhD candidate under the supervision of Asst. Prof. Pieremanuele Canepa and Assoc. Prof. Stefan Adams. Aaron's research focuses on fast ionic conducting Natrium SuperIonic CONductor (NaSICON) solid electrolyte materials for sodium based all-solid-state battery applications.

Please join us!

HOST: Prof Ding Jun