Producing Printable Na-based Solid-State Electrolyte Thin Films Using Open-Air Processing

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Problem Statement: Developing improved Na-based solid-state electrolyte batteries to enable simpler and more cost-effective production.

Background

Lithium-ion batteries, harm the environment due to mining, habitat loss, and problematic disposal. So affordable Na-based solid-state batteries are needed for **safety** and **sustainability**.

Battery				
Lithium-ion	Scarce	100-300 Wh/kg	Expensive	Med Safe
Sodium ion	Abundant	100-160 Wh/kg	Cheapest	Safe
Sodium-based solid-state	Abundant	350 Wh/kg	Economical	Safest

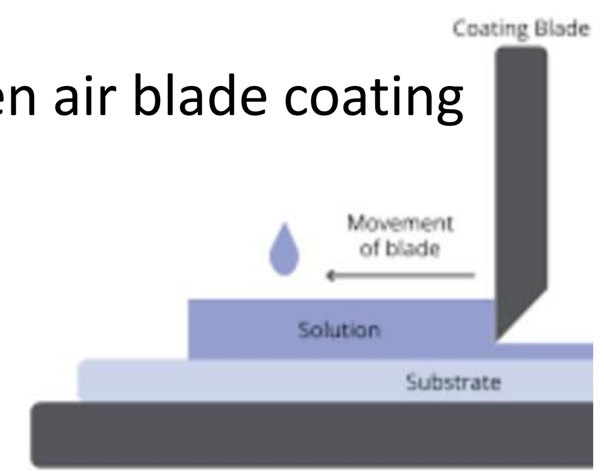
Goals

- Adhesion and uniformity
- Achieve the NASICON phase through XRD analysis
- Achieve proper conductivity through EIS analysis

Process

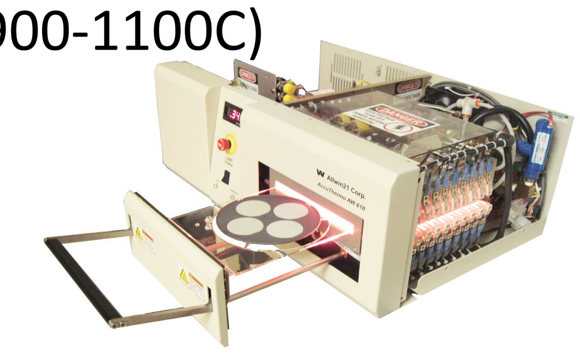
To prepare the NASICON precursor, is wet ball milled from sodium carbonate, ammonium dihydrogen phosphate, silicon dioxide, and 8 mol% YSZ zirconia in ethanol. Then blade coated onto silicon and annealed

Open air blade coating

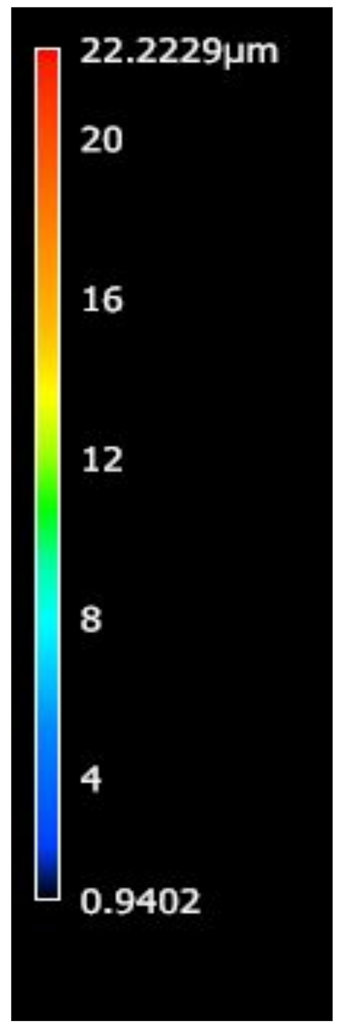


Drying on hot plate

Rapid thermal anneal (900-1100C)



Results

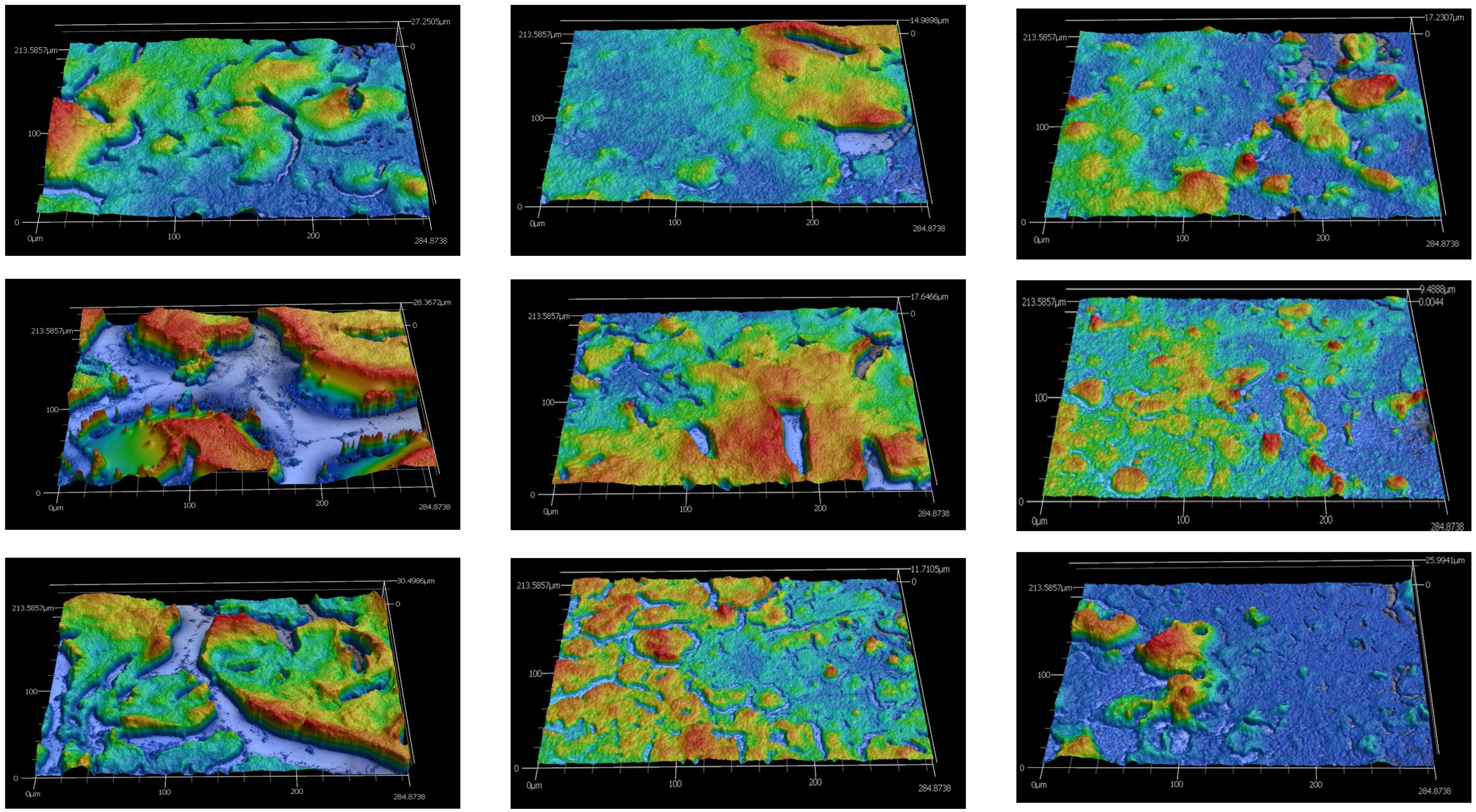


1 part precursor 1 part ethanol | 1 part precursor 1.5 part ethanol | 1 part precursor 2 part ethanol

900°C 60 Seconds

1000°C 60 Seconds

1100°C 30 Seconds



Key Takeaway

- The more diluted in ethanol the NASICON precursor is the more improvement in uniformity and adhesion it has shown

Future Work

- Find ideal conditions for films to achieve NASICON phase
- Find ideal conditions for good conductivity
- Coating on stainless steel for battery application

FURI

Sources

[1] Balaish, Moran, et al. "Processing Thin but Robust Electrolytes for Solid-State Batteries." *Nature News*, Nature Publishing Group, 1 Feb. 2021, www.nature.com/articles/s41560-020-00759-5.

[2] Rolston, Nicholas, et al. "Rapid Open-Air Fabrication of Perovskite Solar Modules." *Joule*, Cell Press, 25 Nov. 2020, www.sciencedirect.com/science/article/pii/S2542435120305092.

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