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Epoxy-Reinforced Ceramic Sheet as a Durable Solid Electrolyte for Solid State Na-Ion Batteries

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Supporting Figures

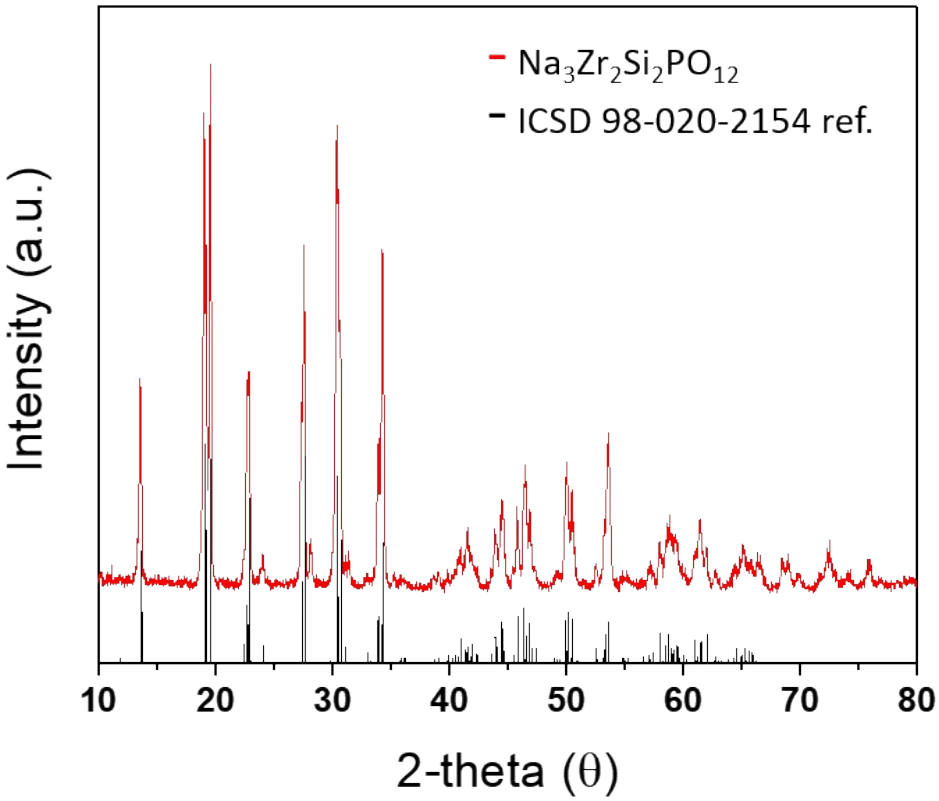


Figure S1. XRD peak of experimental NASICON sample.

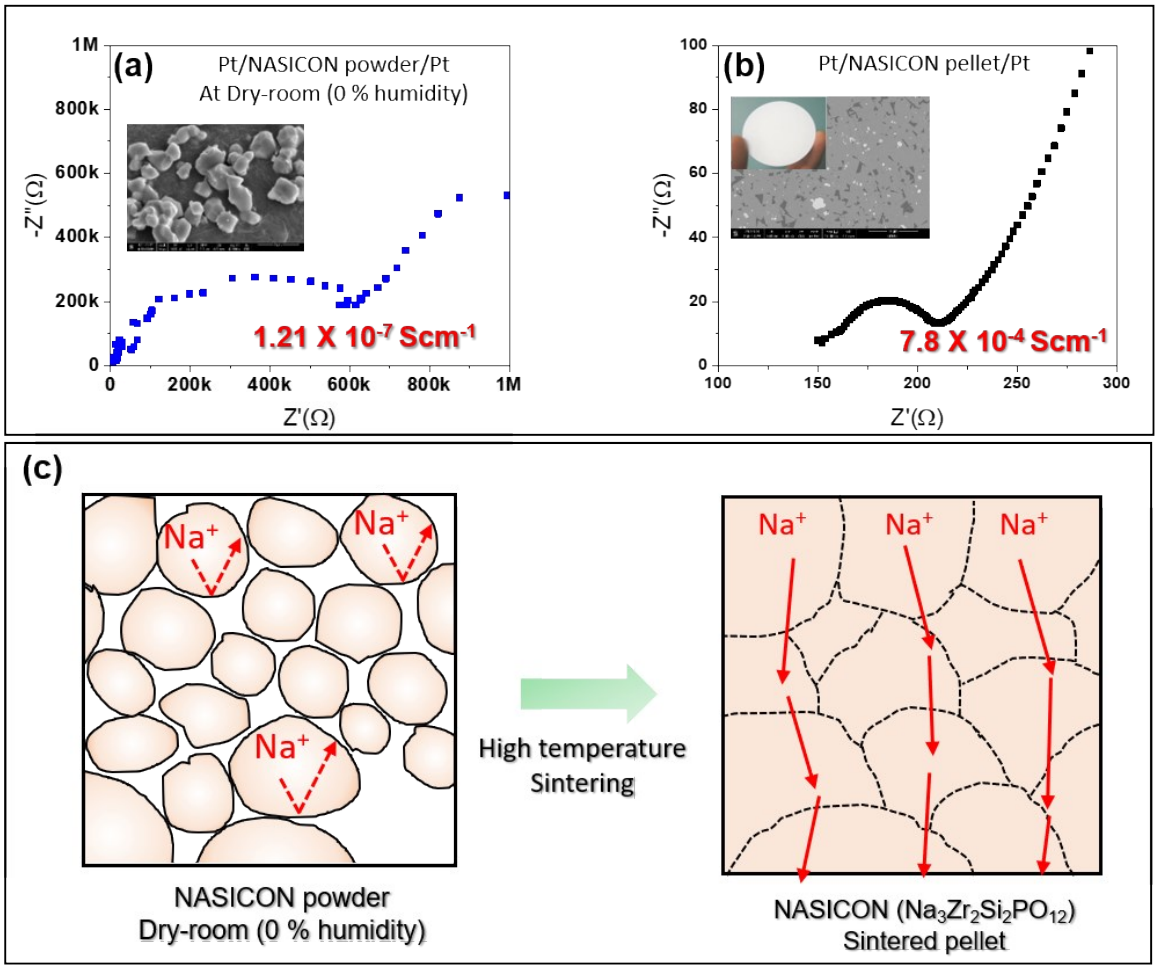
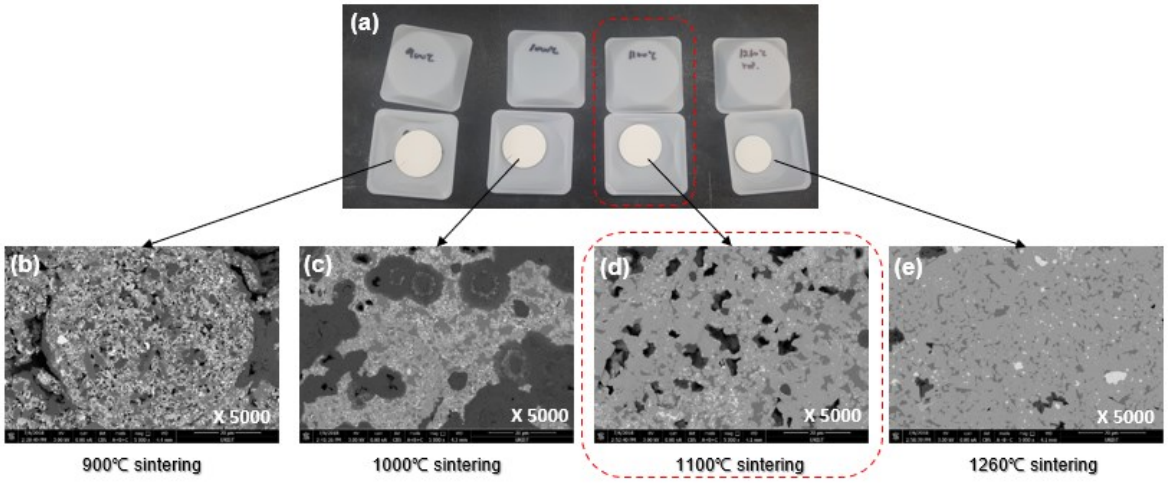


Figure S2. (a) Ionic conductivity of NASICON powder state by EIS data. (b) Ionic conductivity of sintered NASICON pellet state by EIS data. (c) Scheme of Na-ion pathway.



Sintering temperature of NASICON pellet	Ionic conductivity(S/cm)	Porosity(%)
900°C	4.2×10^{-8}	➢ 20
1000°C	1.0×10^{-4}	14 ~ 18
1100°C	1.7×10^{-4}	8 ~ 10
1200°C	5.2×10^{-4}	0.5 ~ 1
1260°C	7.8×10^{-4}	0.3

Figure S3. (a) Sintered NASICON samples with corresponding cross-section SEM image at (b) 900 ℃, (c) 1000 ℃, (d) 1100 ℃, and (e) 1260 ℃. The table shows the ionic conductivity and porosity of each NASICON pellet.

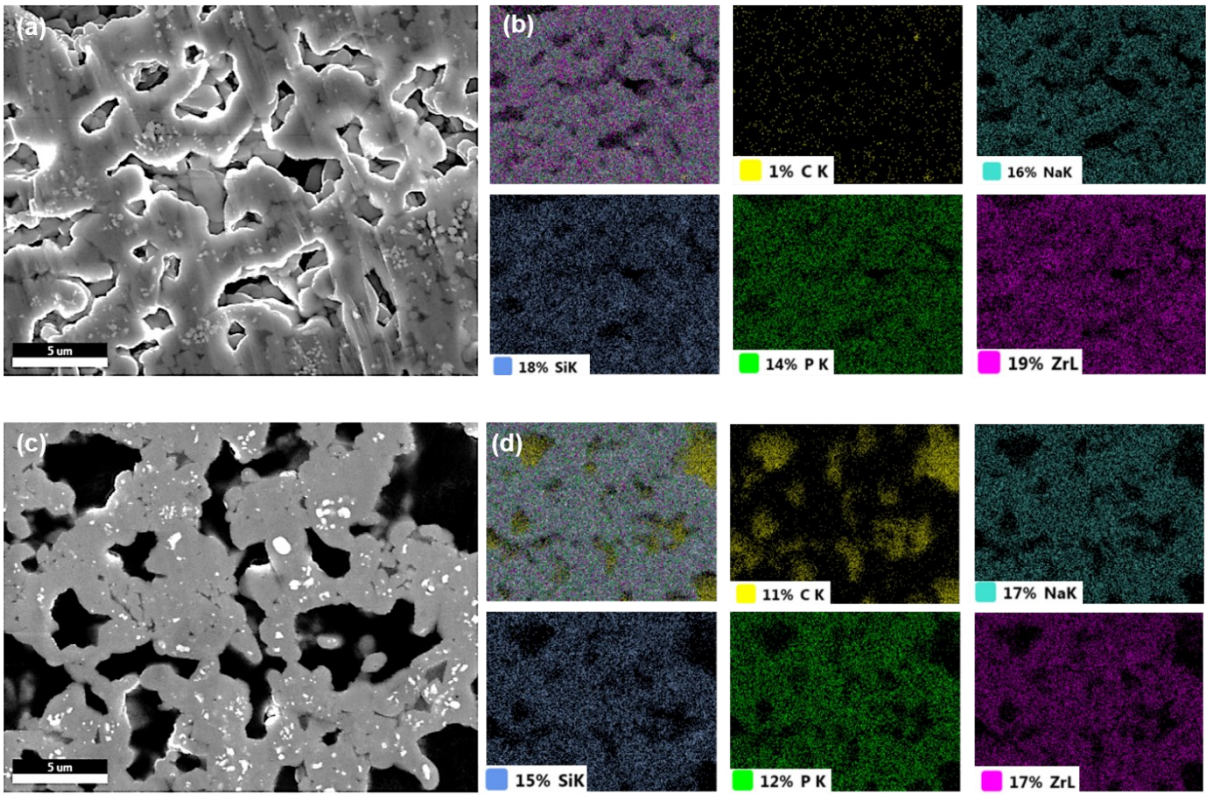


Figure S4. (a) and (b) show cross-section SEM images of 1100 ℃ sintered NASICON pellet (porous NASICON) and EDS results of porous NASICON, respectively. (d) and (e) show the cross-section SEM images of epoxy-NASICON composite and EDS results of epoxy-NASICON composite, respectively.

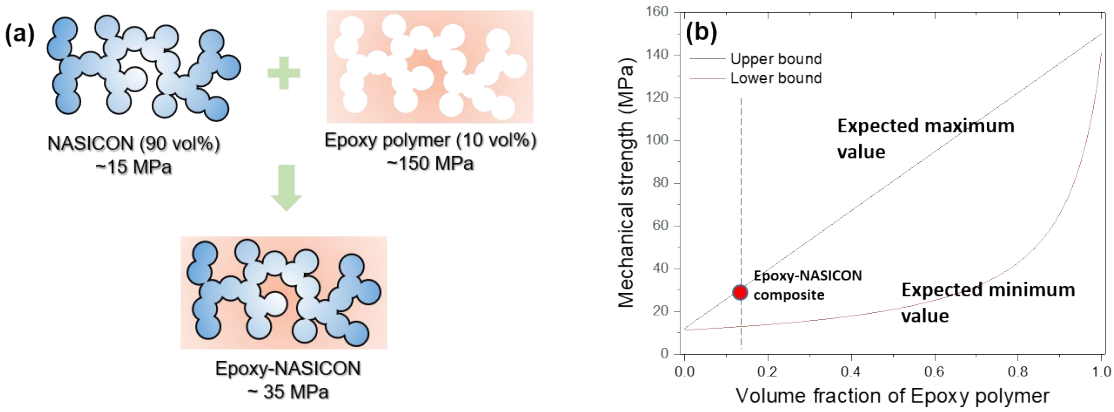


Figure S5. (a) Schemes of composite NASICON and Epoxy polymer materials. (b) Calculation graph for rule of mixture.

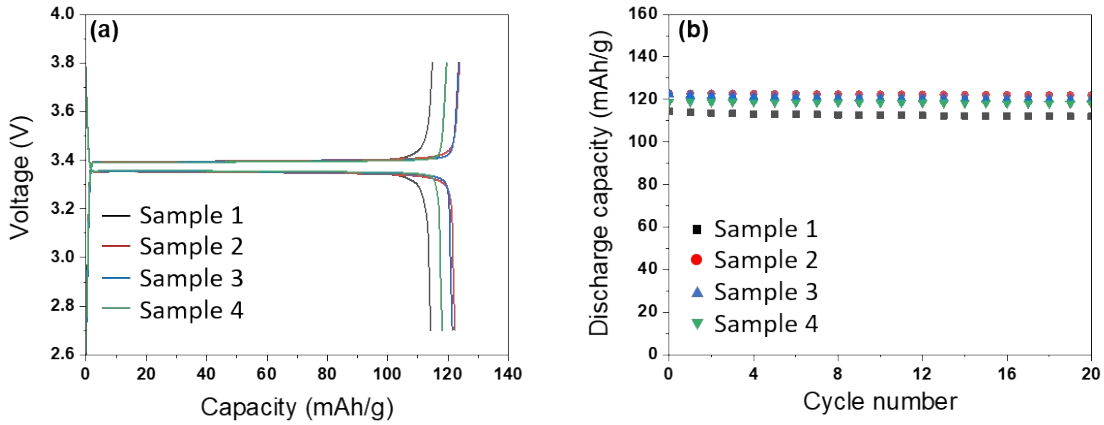


Figure S6. (a) Repeated cell data of each NVP/Epoxy-NASICON/Na metal half-cell first cycle data. (b) Cycle performance of each cell data.

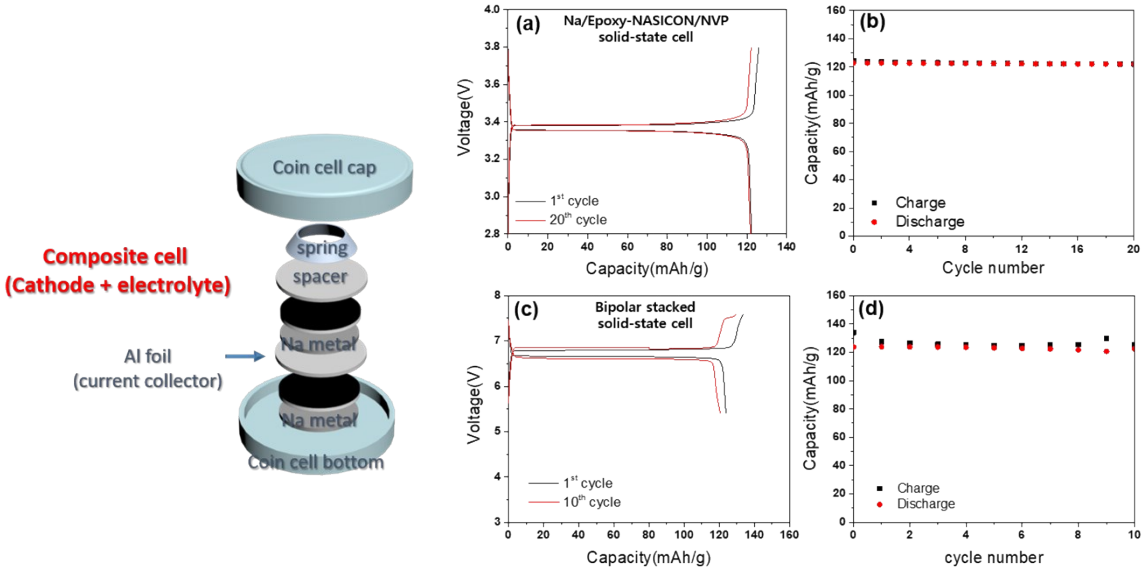


Figure S7. Schematic of bipolar stacked coin-cell. (a) Galvanostatic charge/discharge curve of Na/epoxy-NASICON/$Na_3V_2(PO_4)_3$ solid-state cell at room-temperature at a rate of 0.1 C and (b) cycle ability. (c) Galvanostatic charge/discharge curve of bipolar stacked solid-state cell and (d) cycle ability.

	Sample number	Width(mm)	Thickness (mm)	Breaking load (kgf)	Bending strength (MPa)
NASICON ceramic	1	20.86	1.34	1.953	15
	2	20.86	1.34	2.087	16
	3	20.84	1.33	2.134	17
	4	20.88	1.34	2.123	17
	5	20.84	1.34	1.751	14
Epoxy-NASICON	1	20.83	1.30	3.704	31
	2	20.86	1.30	4.816	40
	3	20.94	1.31	4.331	35
	4	20.84	1.27	4.817	42
	5	20.93	1.32	3.885	31

Table S1. Data for each bending strength measurement.