

Supplementary Information

Proton conductor NASICON-structure $\text{Li}_{1+x}\text{Cd}_{x/2}\text{Zr}_{2-x/2}(\text{PO}_4)_3$ as solid electrolyte for Intermediate-temperature fuel cell

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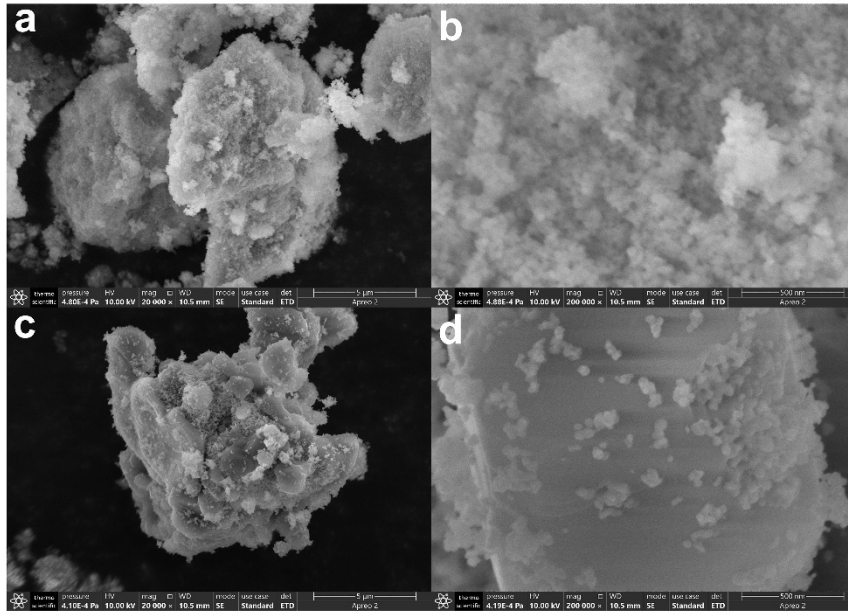


Fig. S1 SEM analysis of (a-b) $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ and (c-d) $\text{CdZr}_4(\text{PO}_4)_6$ samples.

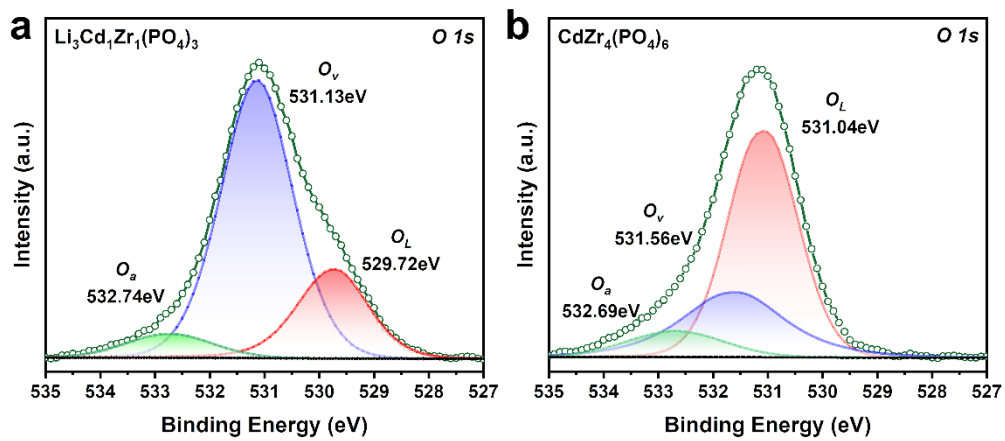


Fig. S2 XPS spectra of O 1s for (a) $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ and (b) $\text{CdZr}_4(\text{PO}_4)_6$ samples.

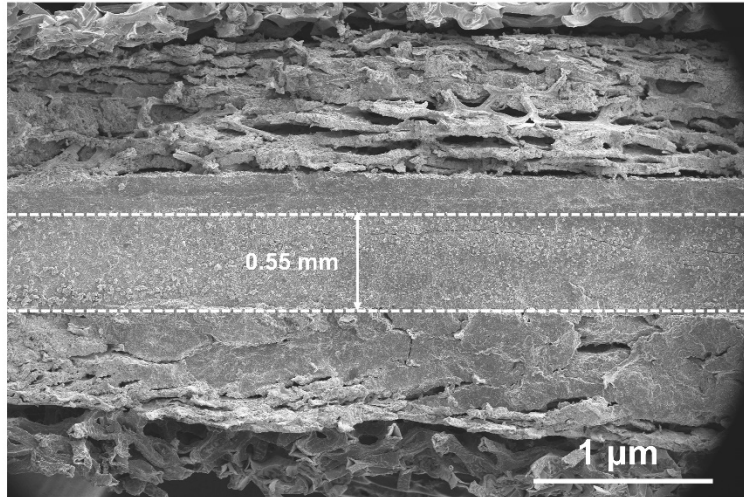


Fig. S3 Cross-section SEM image of $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ fuel cell device.

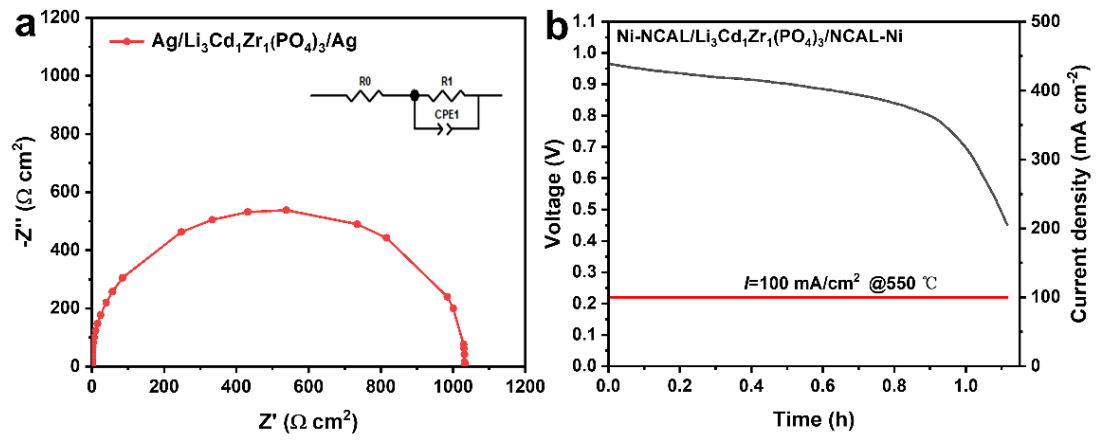


Fig. S4 (a) Electrochemical impedance spectroscopy (EIS) plots of the Ag/ $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ /Ag device at 550 °C. (b) Durability performance test of $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ device without protection layer at 550 °C.

Table S1

EIS simulation results of $\text{Li}_{1+x}\text{Cd}_{x/2}\text{Zr}_{2-x/2}(\text{PO}_4)_3$ ($x=0.5,1,1.5,2$) and $\text{CdZr}_4(\text{PO}_4)_6$ fuel cell devices under H_2/air conditions at 550 °C.

	R_0	$\text{CPE}_1\text{-T}$	$\text{CPE}_1\text{-P}$	R_1	$\text{CPE}_2\text{-T}$	$\text{CPE}_2\text{-P}$	R_2
$\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$	0.45458	0.10283	0.83980	0.07546	0.90656	0.67246	0.22876
$\text{Li}_{2.5}\text{Cd}_{0.75}\text{Zr}_{1.25}(\text{PO}_4)_3$	0.49813	0.05835	0.92439	0.04618	3.23800	0.47331	0.24299
$\text{Li}_2\text{Cd}_{0.5}\text{Zr}_{1.5}(\text{PO}_4)_3$	0.55451	0.07129	0.82749	0.08041	3.01400	0.46587	0.26833
$\text{Li}_{1.5}\text{Cd}_{0.25}\text{Zr}_{1.75}(\text{PO}_4)_3$	0.69609	0.00016	1.51900	0.01086	0.01058	1.00400	0.07542
$\text{CdZr}_4(\text{PO}_4)_6$	0.96314	4.22E-12	3.28500	0.02862	0.01788	0.90184	0.14331

Table S2

EIS simulation results of NCAL/ $\text{Li}_3\text{Cd}_1\text{Zr}_1(\text{PO}_4)_3$ /NCAL sample under H_2 /air conditions in 460-550 °C.

	R_0	$\text{CPE}_1\text{-T}$	$\text{CPE}_1\text{-P}$	R_1	$\text{CPE}_2\text{-T}$	$\text{CPE}_2\text{-P}$	R_2
550 °C	0.45458	0.10283	0.83980	0.07546	0.90656	0.67246	0.22876
520 °C	0.51269	0.08595	0.79216	0.11345	0.89905	0.61399	0.18567
490 °C	0.54158	0.10640	0.67100	0.27597	2.54300	0.55208	0.32452
460 °C	0.58895	0.06660	0.72153	0.33522	1.02100	0.60640	0.65182