**Supplementary Information**

# Processing and characterisation of $BaZr_{0.8}Y_{0.2}O_{3-\delta}$ proton conductor densified at 1200 °C

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Table S1. Selected lattice parameters of BZY20 prepared by sol gel after various thermal treatments refined from XRD data using $CaF_2$ as an internal standard.

| Thermal treatment | a (Å) |
|---|---|
| 750 °C for 4 hours | 4.2035 (2) |
| 1200 °C for 4 hours | 4.20521 (4) |
| 1650 °C for 4 hours | 4.21102 (5) |
| sintered at 1200 °C then exposed to dry 10% $CO_2$:90% Ar then 10% $H_2$:90% $N_2$ at 500 °C | 4.20758(4) |
| sintered at 1200 °C then exposed to wet 10% $CO_2$:90% Ar then 10% $H_2$:90% $N_2$ | 4.19785(3) |

Table S2. Structural parameters and agreement factors for BZY20, prepared by sol gel and sintered at 1200 or 1650 °C with Ba excess and ZnO sintering aid, obtained from XRD data.

| | 1200°C ($Pm\bar{3}m$) | 1650°C ($Pm\bar{3}m$) |
|---|---|---|
| *a* (Å) | 4.20521 | 4.21102 |
| V( Å$^3$) | 74.364 | 74.673 |
| Ba position | ½ ½ ½ | ½ ½ ½ |
| $U_{iso}$×100 (Å$^2$) | 1.51(3) | 1.82 (4) |
| Occ | 1.0 | 1.0 |
| Zr/Y position | 0 0 0 | 0 0 0 |
| $U_{iso}$×100 (Å$^2$) | 1.05 (4) | 1.16(5) |
| Occ | 0.8/0.2 | 0.8/0.2 |
| O position | ½ 0 0 | ½ 0 0 |
| $U_{iso}$×100 (Å$^2$) | 1.2(1) | 2.0(2) |
| Occ | 2.9 | 2.9 |
| $\chi^2$ | 2.45 | 2.47 |
| $R_{exp}$ | 5.67 | 6.36 |
| $R_{wp}$ | 8.88 | 10.0 |
| $R_{B,BZY}$ | 2.97 | 2.03 |

Fig. S1.  Photographic image of pellet fracture exposed to laboratory air for 14 days.