

Supporting Information

**Performance of fuel-electrode-supported tubular protonic
ceramic cells prepared through slip casting and dip coating
methods**

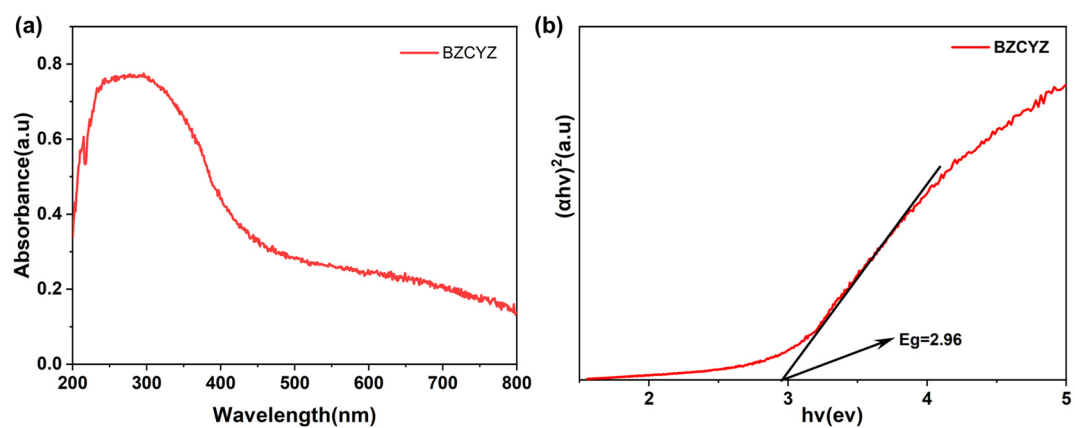


Figure S1. Band structure and optical property of obtained BZCYZ. (a) UV-vis diffuse reflectance spectra. (b) The bandgap energy is 2.96 eV based on the UV-Vis Kubelka-Munk function.

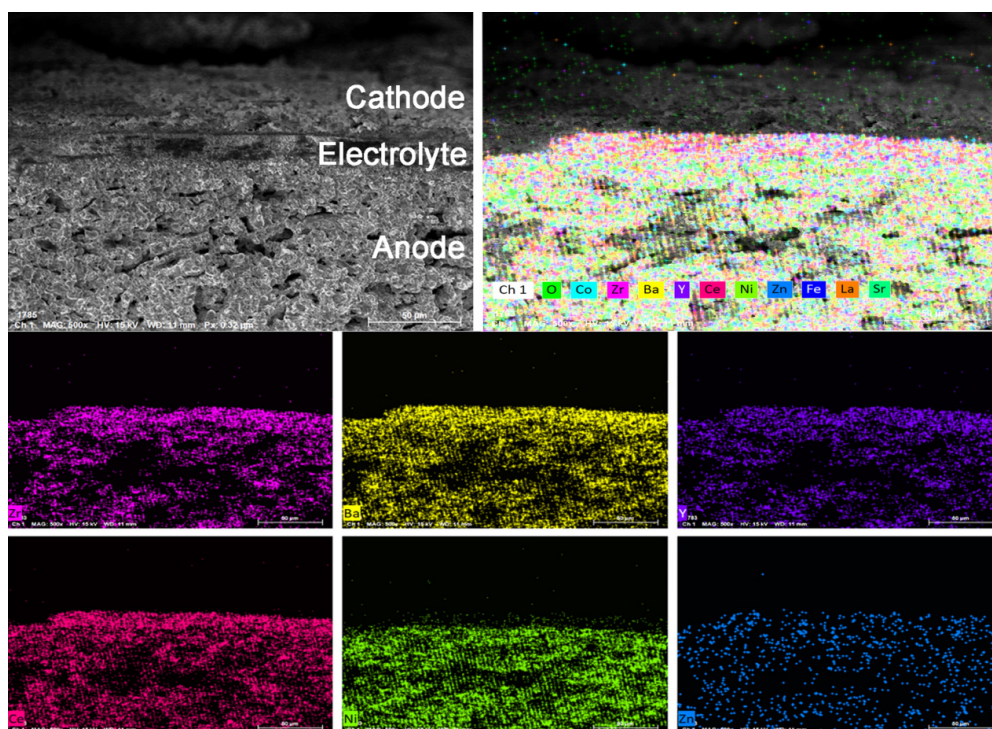


Figure S2. The SEM and EDX images of the anode support cross-section after stability test.

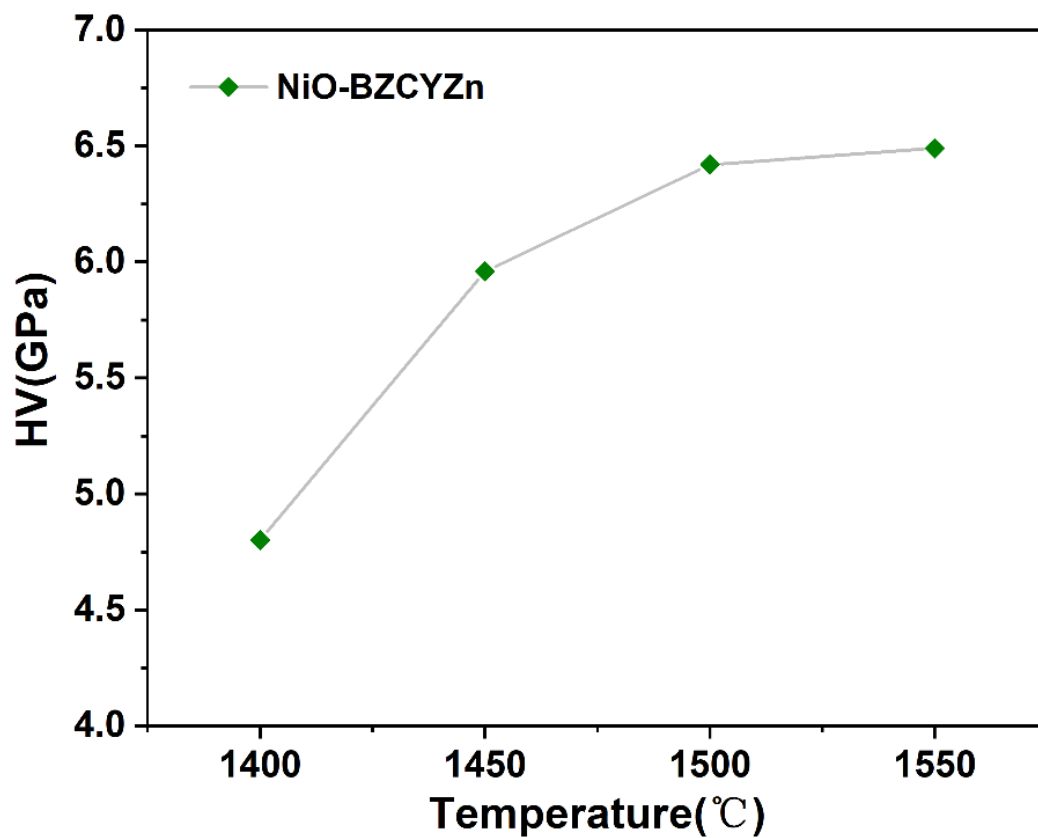


Figure S3. The Vickers hardness of obtained proton tubular fuel cell at different sintering temperatures.

During the sintering of the proton ceramics, high temperature sintering leads to evaporation of volatile elemental Ba, which reduces the electrolyte conductivity. While low temperature sintering results in low density electrolyte, so we selected 1450°C as sintering temperature.

Table S1. The Comparison of electrocatalytic CO₂ reduction with other single cell configuration.

Configuration of single cell	Temperature (°C)	Performance	Reference
LSCM/BaCe _{0.5} Zr _{0.3} Y _{0.16} Zn _{0.04} O _{3-δ} (1 mm)/NiO-BZCYZ	600	2 V (0.1 A cm ⁻²)	<i>J. Power Sources</i> 2013, 232, 187-192.
Pt/BaZr _{0.3} Ce _{0.5} Y _{0.16} Zn _{0.04} O _{3-δ} (200 μm)/Pt	650	2 V (0.08 A cm ⁻²)	<i>Solid State Ionics</i> 2012, 216, 36-40.
LNO ₄ -BCZD/BaCe _{0.5} Zr _{0.3} Dy _{0.2} O _{3-δ} (30 μm)/NiO-BCZD	600	1.3 V (0.17 A cm ⁻²)	<i>J. Mater. Chem. A</i> 2016, 4, 15390-15399.
LNO ₄ /BaZr _{0.4} Ce _{0.4} Y _{0.2} O _{3-δ} (53 μm)/Ni-BZCY	700	0.6 V (0.133 A cm ⁻²)	<i>J. Power Sources</i> 2017, 348, 9-15.
LSM-BZCY/BaZr _{0.7} Ce _{0.2} Y _{0.1} O _{3-δ} (100 μm)/Pr ₆ O ₁₁ -CeO ₂	700	2.5 V (0.048 A cm ⁻²)	<i>J. CO₂ Util.</i> 2019, 34, 231-238
SCFN/BZ _{0.1} Ce _{0.7} Y _{0.1} Yb _{0.1} O _{3-δ} (26 μm)/Ni-BZCYYb	600	1.4 V (0.4 A cm ⁻²)	<i>Adv. Energy Mater.</i> 2021, 11, 2101899.
LSCF-BZCYZ/BaZr _{0.4} Ce _{0.4} Y _{0.15} Zn _{0.05} O _{3-δ} (25 μm)/Ni-BZCYZ	650	1.4 V (0.35 A cm ⁻²)	this work
LSCM: La _{0.75} Sr _{0.25} Cr _{0.5} Mn _{0.5} O _{3-δ} LNO ₄ : La ₂ NiO _{4-δ} LSM: La _{0.8} Sr _{0.2} MnO _{3-δ} SCFN: CeO ₂ +Sr _{0.9} Fe _{0.8} O _{3-δ}			