Electronic Supplementary Information (ESI)

The effect of grain size on the hydration of $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ proton conductor studied by ambient pressure X-ray photoelectron spectroscopy

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Table S1: List of the precursors used for the synthesis of the SPS, SSR and HT samples.

	SPS	SSR	HT
Barium carbonate	Aldrich, 99+ %	Aldrich, 99+ %	Fluka, purity: 99%
Zirconium oxide	Aldrich submicron powder: 99.5 %, 5.3 wt. % of yttria	Aldrich submicron powder: 99.5 %, 5.3 wt. % of yttria	Tosoh, purity: 99.9%
Yttrium oxide	Sigma-Aldrich, 99.99 %	Sigma-Aldrich, 99.99 %	Stanford Materials, purity:99.9%

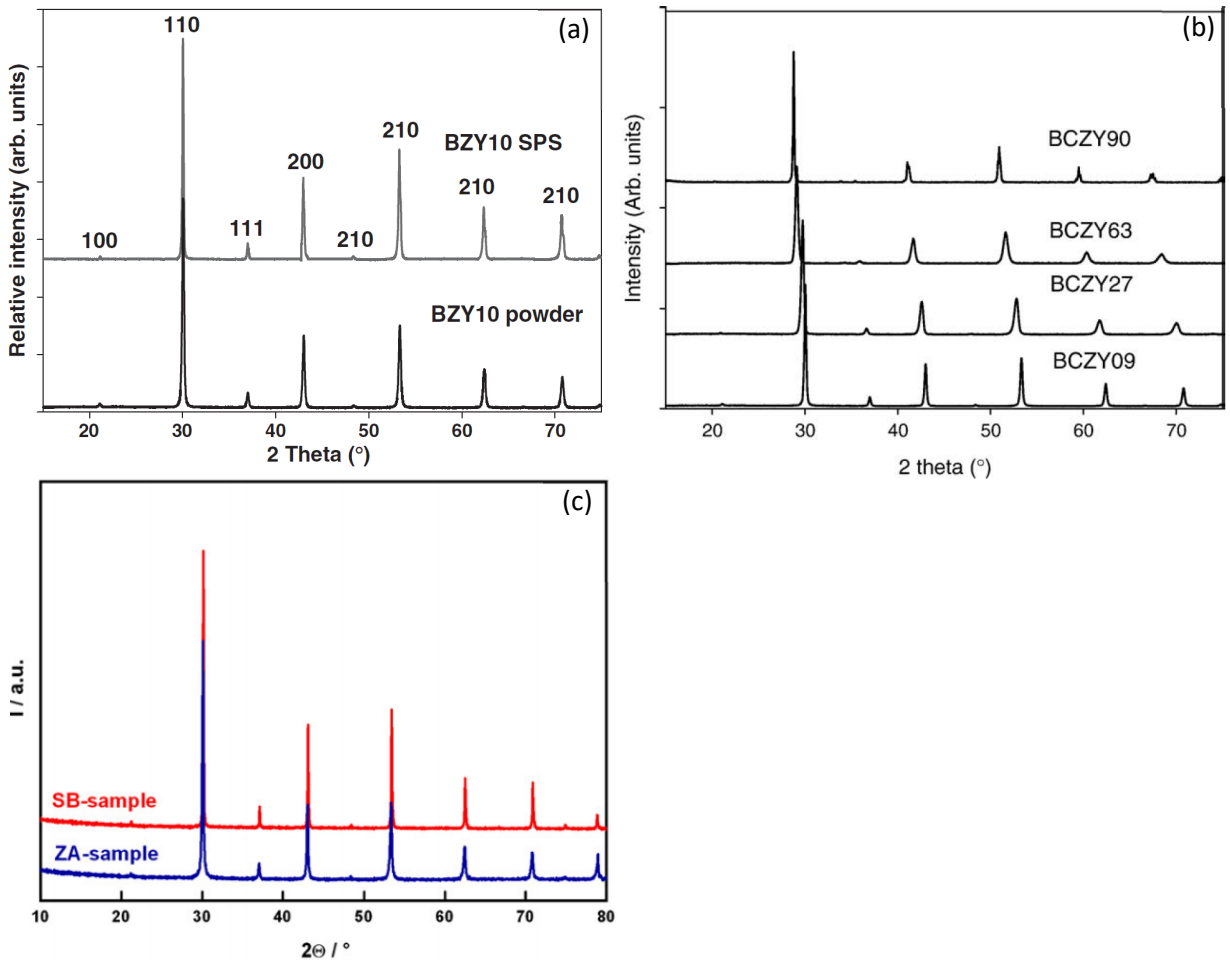

Figure S1: X-Ray diffraction patterns of the SPS (a), SSR labeled BCZY09 (b) and HT labeled ZA (c) samples. Reproduced from [41], [7] and [42] respectively, by permission of Elsevier LDT.

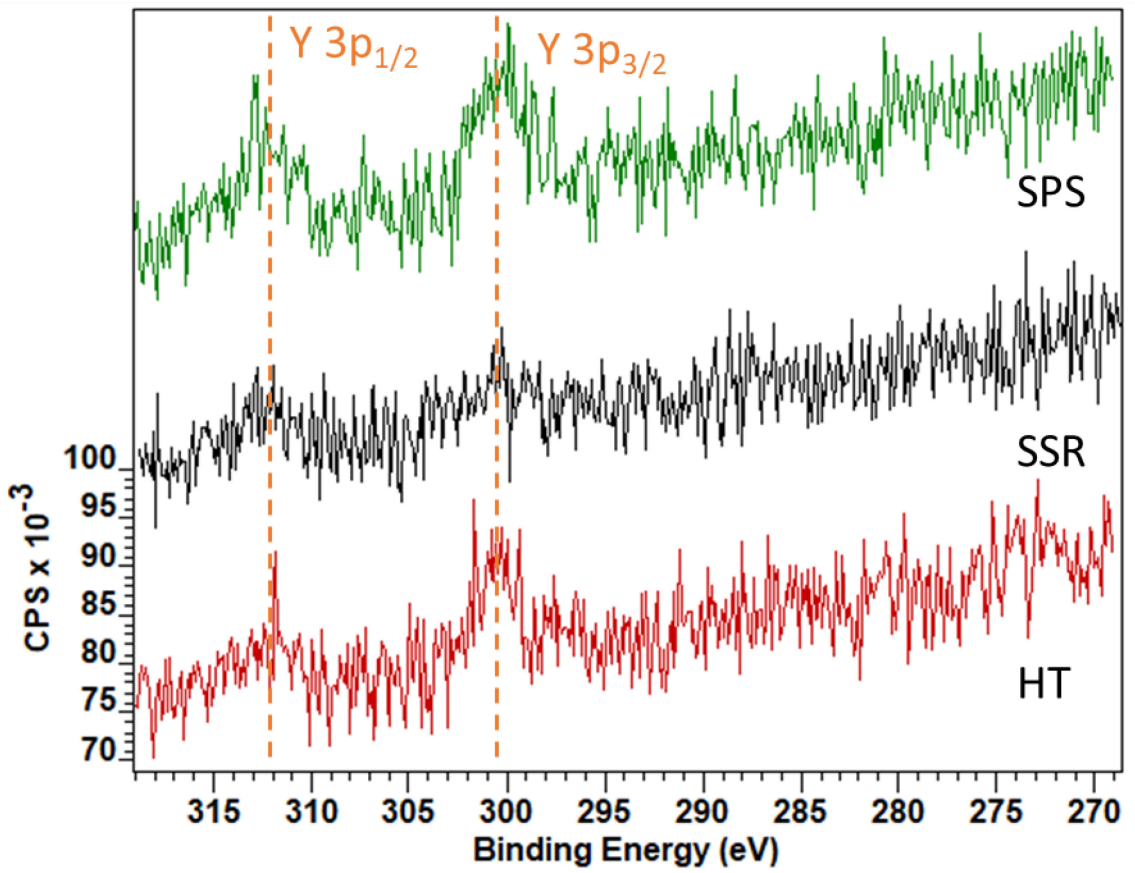

Figure S2: C 1s APXPS spectra of the three $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ pellets collected with incident X-ray energy PE= 710 eV at 500 °C at a $p(O_2)$ of 100 mTorr. No formation of carbonate was observed.

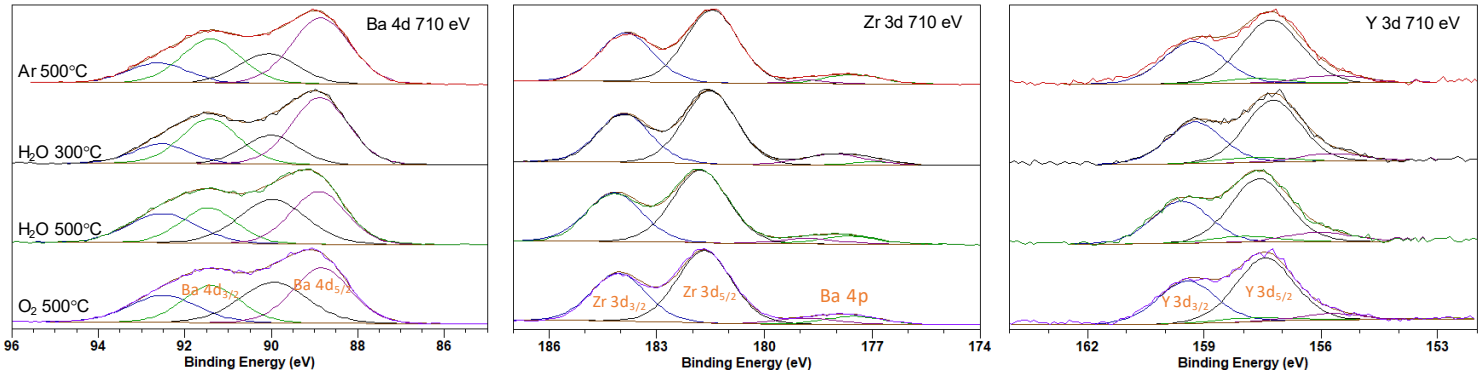

Figure S3: Ba 4d, Zr 3d and Y 3d in situ APXPS spectra of the $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ pellet obtained by spark plasma sintering (SPS) collected with incident X-ray energy of 710 eV as a function of environment (100 mTorr of Ar, H_2O or O_2) and temperature (500 °C and 300 °C).

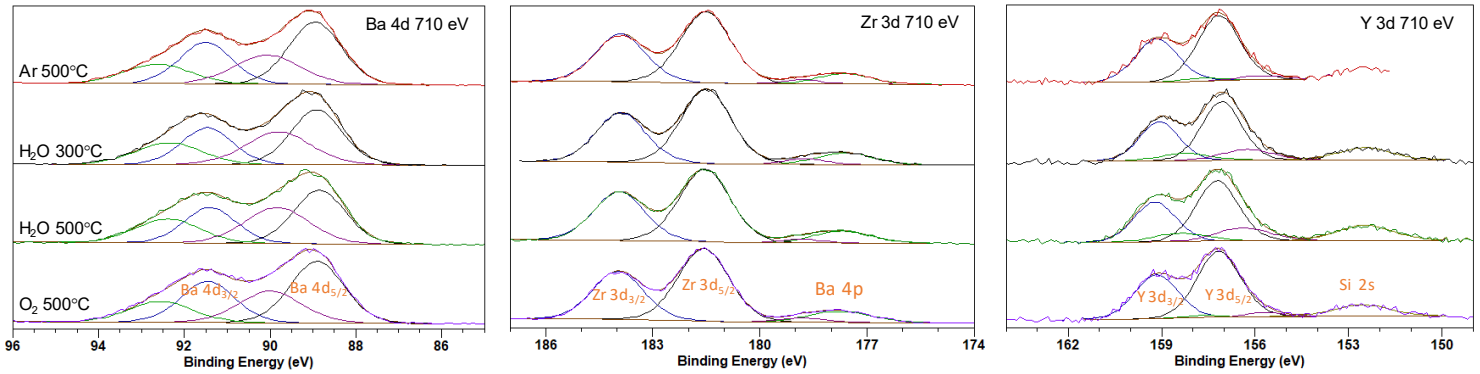

Figure S4: Ba 4d, Zr 3d and Y 3d in situ APXPS spectra of the $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ pellet obtained by solid state reaction (SSR) collected with incident X-ray energy of 710 eV as a function of environment (100 mTorr of Ar, H_2O or O_2) and temperature (500 °C and 300 °C).

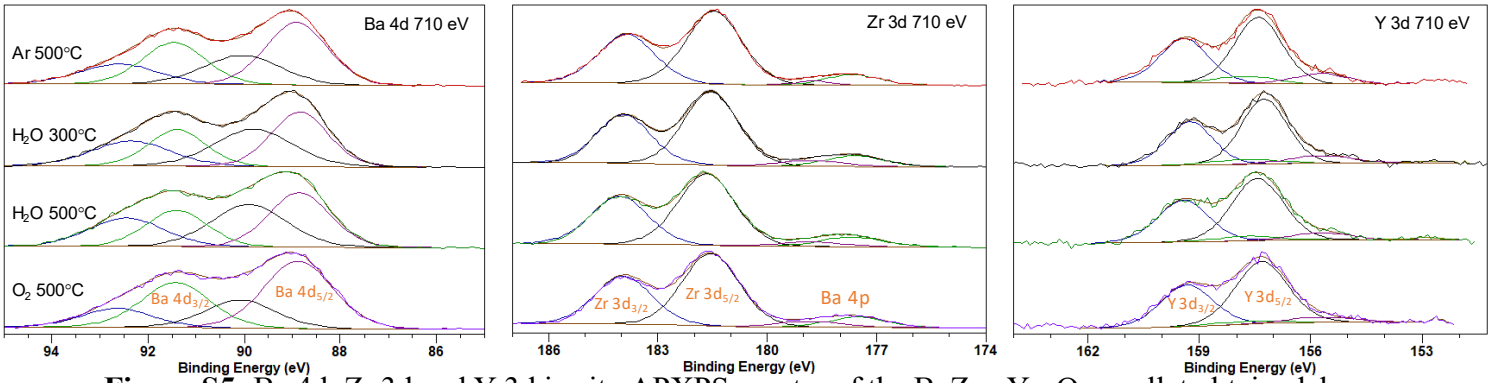

Figure S5: Ba 4d, Zr 3d and Y 3d in situ APXPS spectra of the $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ pellet obtained by high temperature annealing (HT) collected with incident X-ray energy of 710 eV as a function of environment (100 mTorr of Ar, H_2O or O_2) and temperature (500 °C and 300 °C).

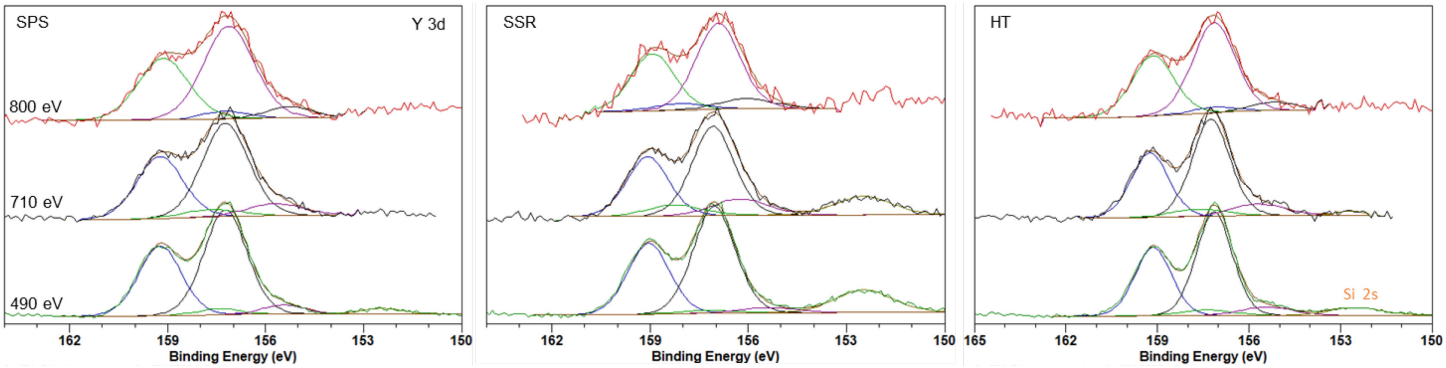

Figure S6: Y 3d *in situ* APXPS spectra of the $BaZr_{0.9}Y_{0.1}O_{3-\delta}$ (a) SPS, (b) SSR and (c) HT pellets as a function of the incident X-ray energy (800 eV, 710 eV, 490 eV) at 300 °C at a $p(H_2O)$ of 100 mTorr. The collection at three different photon energies provides information from the surface to higher depth into the pellets (20, 18 and 12 Å respectively) according to the IMFP calculation for Y 3d.