**Supplementary information**



Fig. S1. XRD patterns for Sm2-xCaxZr2O7-δ (x = 0; 0.05; 0.075; 0.1; 0.125; 0.15) powders calcined at 1000oC for 20 hours in dry air.



Fig. S2.Temperature dependencies of relative linear expansion and narrowing for Sm2-xCaxZr2O7-δ (x = 0; 0.05; 0.075; 0.1; 0.125; 0.15) dry (a) and wet (b) atmospheres.



Fig. S3**.** Сhemical expansion of SCZ5 and SCZ10 samples during the transition from a dry atmosphere (pH2O≈0.1kPa) to humidified atmospheres (pH2O=0.6, 2.8kPa) at a constant temperature T=600oC.

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Fig. S4. XRD patterns of the SCZ5 sample before (a) and after (b) exposure in hydrogen (250 hours) at 850oC





Fig. S5. HAADF and SAED cross-sectional images of SCZ5 and SCZ10 samples in the region of the triple junction of grains with STEM-EDX maps of elements distribution.