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Electronic Supplementary Information (ESI)

Zn-modified ceria as a redox material for thermochemical H_2O and CO_2 splitting: effect of a secondary ZnO phase on its thermochemical activity†

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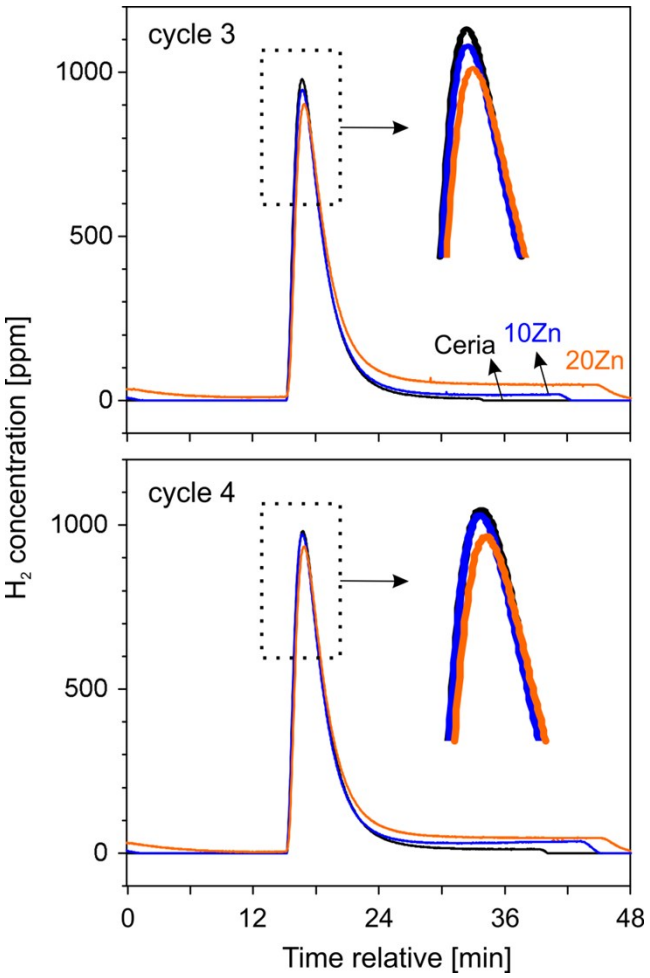

Fig. S1 H_2 evolution profiles of native ceria (black line), 10Zn (blue line) and 20Zn (orange line) during reoxidation of the 3rd and 4th H_2O-splitting cycles at 1000 °C, illustrating a slower reoxidation of Zn-modified ceria compared to native ceria.

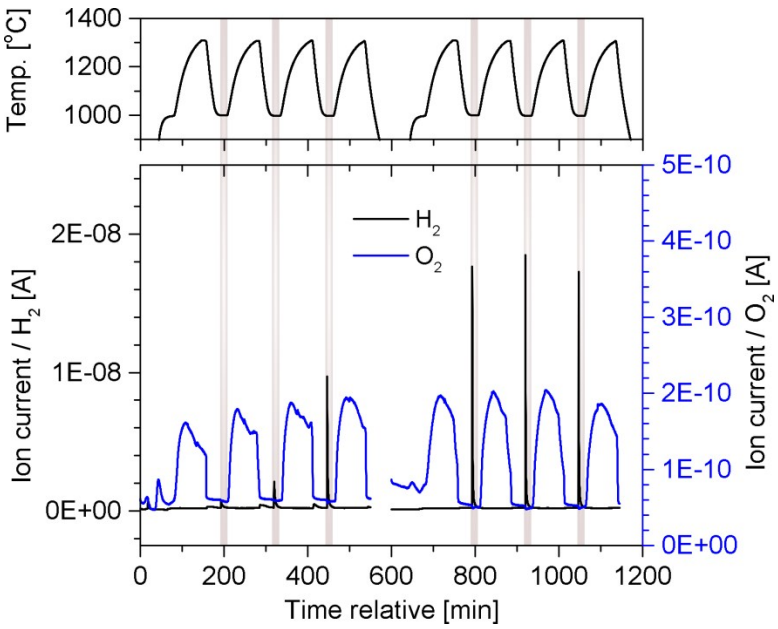

Fig. S2. Ion current profiles of O_2 and H_2 for 6 H_2O-splitting cycles using 20Zn. The reoxidation periods are marked by grey strips.

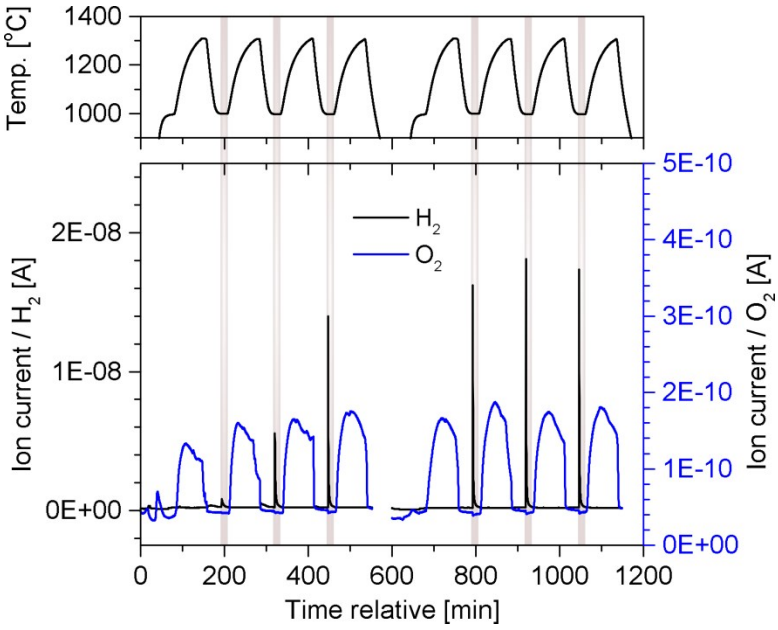

Fig. S3. Ion current profiles of O_2 and H_2 for 6 H_2O-splitting cycles using 10Zn. The reoxidation periods are marked by grey strips.

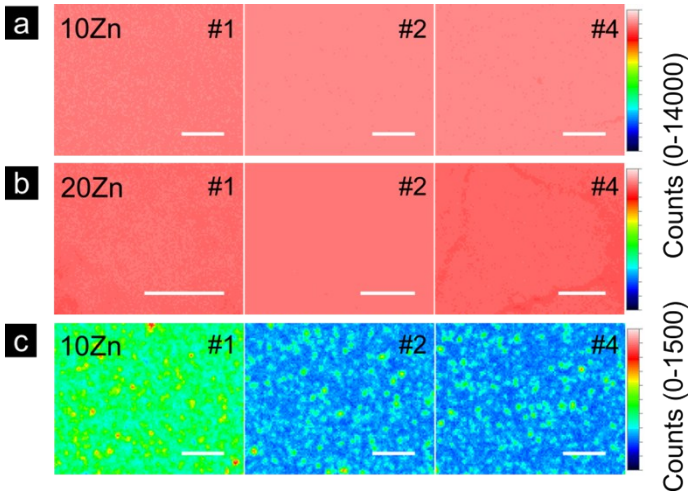

Fig. S4. Lab XRF cerium maps of (a) 10Zn and (b) 20Zn after 1, 2 and 4 H_2O-splitting cycles, plotted in the same color scale. The maps show a homogeneous distribution of cerium. The scale bars in all maps represent a length of 500 µm. The zinc maps of 10Zn, plotted in a smaller scale than in Fig. 4c, are presented in (c).

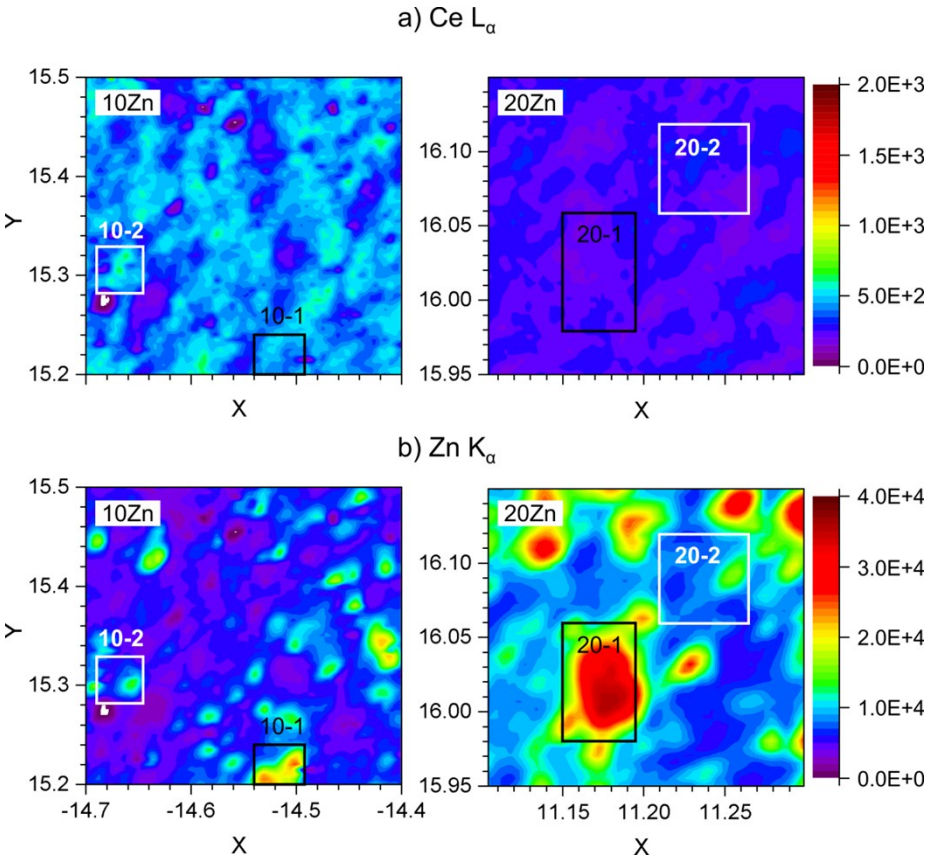

Fig. S5. Synchrotron-based XRF overview maps (X, Y coordinates in millimeter) of 10Zn (left) and 20Zn (right) after 4 H_2O-splitting cycles: a) cerium maps, b) zinc maps. Regions marked with "10-1" and "10-2" represent a Zn-rich and a Ce-rich region, respectively for 10Zn. Likewise, regions marked with "20-1" and "20-2" represent a Zn-rich and a Ce-rich region for 20Zn, respectively. These four regions are further mapped with higher spatial resolution and dwell time, with the results shown in the insets of Fig. 5.

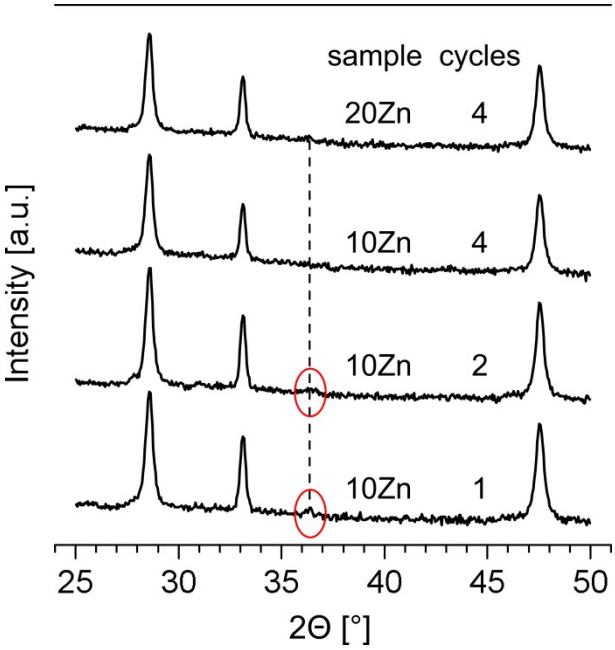

Fig. S6. XRD patterns, obtained conventional X-ray, of 10Zn and 20Zn subjected to multiple H_2O-splitting cycles (intensity in logarithmic scale). ZnO is detected in samples subjected to one or two cycles, with marked peaks corresponding to wurzite ZnO (101).