

## Supplementary materials for

### $\text{Ce}^{\text{III}}_{1-x}\text{Ce}^{\text{IV}}_x\text{AlO}_{3+y}$ - unexpected product of solid state reaction in $\text{CeO}_2\text{-Al}_2\text{O}_3$ system.

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Ce-Al-O\_M sample has been prepared by water-in-oil microemulsion method. Two microemulsions containing 4% aqueous phase with Ce- and Al- ions (Ce:Al = 1:1.3 mol) or ammonia were prepared. The microemulsions had identical organic phase composed of 0.01M Triton X-100/0.23M cycloheksane/0.05M 1-pentanol. The aqueous phase was composed of 0.2M aqueous solution of cerium nitrate and aluminium nitrate or 25% aqueous solution of ammonia, respectively. The microemulsions were mixed and then vigorously stirred for 0.5 h at room temperature. The resulting product was centrifuged and washed with methanol to remove the remaining oil and surfactant. Obtained product was dried at 50 °C in static air and heated at temperatures between 550 and 850 °C in hydrogen flow for 3 h.

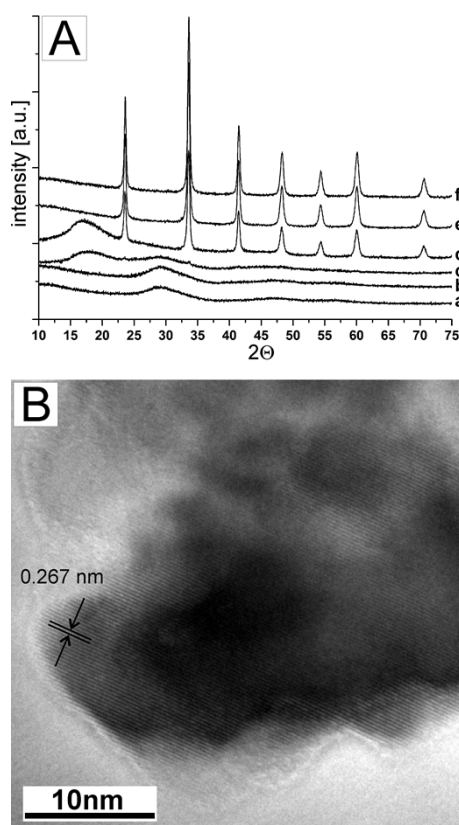


Fig. 1S. A) XRD patterns of Ce-Al-O\_M samples heated at a) 550, b) 700, c) 750, d) 800, e) 830, f) 850 °C in hydrogen flow, B) HR-TEM image of tetragonal  $\text{CeAlO}_3$  crystal.

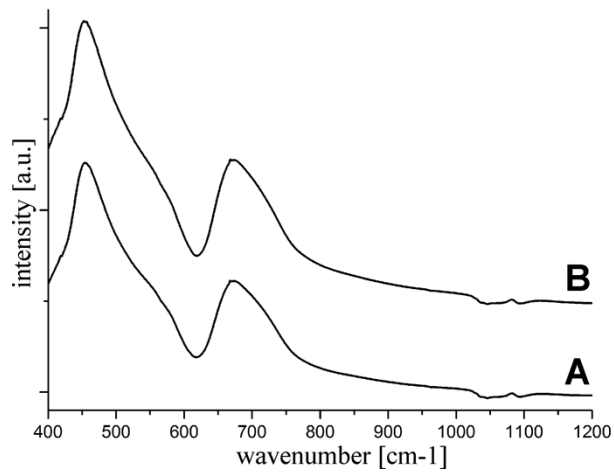


Fig. 2S. FTIR spectra of Ce-Al-O\_M samples heated at A) 800 and B) 850 °C in hydrogen flow.

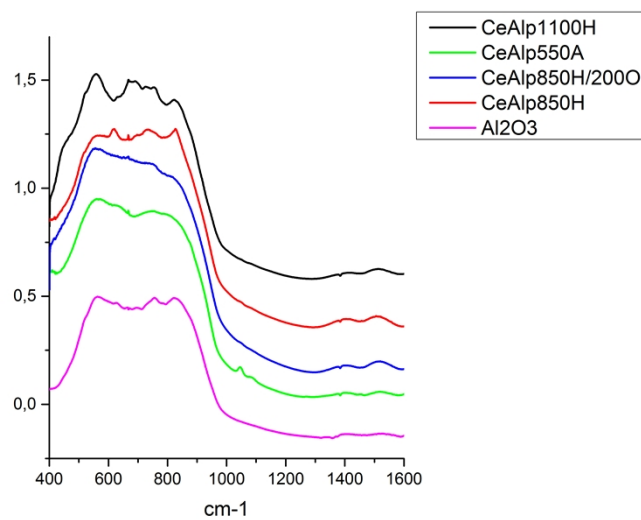


Fig. 3S. FTIR spectra of CeAlP samples and pure Al<sub>2</sub>O<sub>3</sub> (PURALOX) as a reference.

CeAlP\_850H-Et sample has been prepared by simple impregnation of a high surface  $\text{Al}_2\text{O}_3$ , Puralox by Sasol (nominal surface area  $230 \text{ m}^2/\text{g}$ ), with an ethanolic solution of cerium nitrate. After drying at  $200^\circ\text{C}$ , the sample was pre-heated at  $550^\circ\text{C}$  for 3 h in oxygen flow. Such standardized samples were heated at  $850^\circ\text{C}$  in a hydrogen flow.

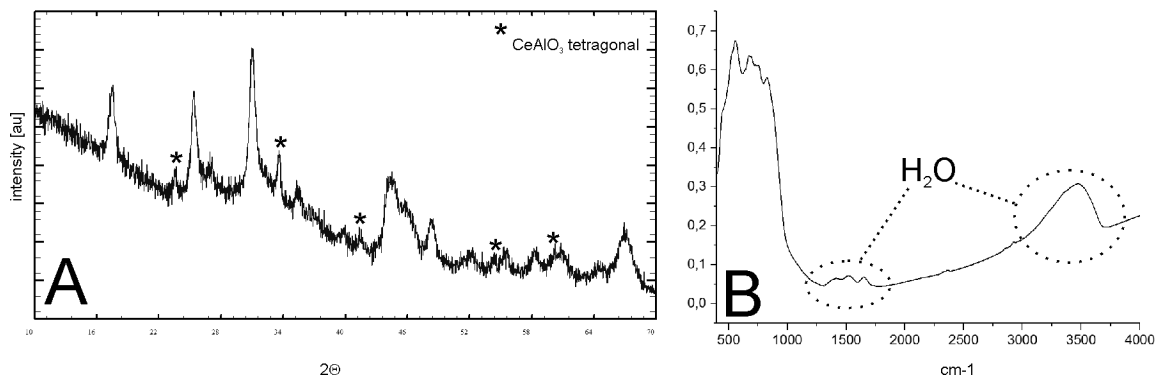


Fig. 4S. A) XRD pattern and B) FTIR spectrum of CeAlP\_850H-Et sample.