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Supporting Information

69451 Weinheim, Germany

Synthesis and Oxygen Storage Capacity of Two-Dimensional Ceria Nanocrystals**

*Dianyuan Wang, Yijin Kang, Vicky Doan-Nguyen, Jun Chen, Rainer Küngas, Noah L. Wieder, Kevin Bakhmutsky, Raymond J. Gorte, and Christopher B. Murray**

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Supporting information

The synthesis was carried out by using standard Schlenk technique under nitrogen gas and commercially available reagents as received. Cerium (III) acetate hydrate ($Ce(Ac)_3$, 99.99%), oleic acid (90%), oleylamine (>70%), 1-octadecene (90%), cerium (III) nitrate hexahydrate ($Ce(NO_3)_3{\cdot}6H2O$, 99.99%), and urea ($CO(NH_2)_2$, ≥99.5%) were purchased from Sigma Aldrich. Ethylene glycol (99+ %) was obtained from ACROS. Sodium diphosphate ($Na_4P_2O_7$) was obtained by heating sodium phosphate (Na_2HPO_4, 99.8%, fisher chemicals) at 400ºC for 20 hours. Sodium oleate (NaOL) was from Tokyo Chemical Industry Co. Ltd.

Combustion synthesis of CeO_2 nanocrystals: 0.22g cerium (III) nitrate hexahydrate and 0.9g urea were dissolved in 10ml de-ionized water. The resulting solution was concentrated by heating it in a porcelain crucible until excess free water evaporated. When the water was almost gone, the temperature would rise quickly and ignite. The combustion process lasted only a few seconds and light-yellow foam was obtained. And then the foamy product was calcined at 1000ºC for 1 hour in air.

Hydrothermal synthesis of CeO_2 nanospheres: 0.5ml 0.5M $Ce(NO_3)_3$ aqueous solution was mixed with 15ml ethylene glycol. The formed solution was transferred into a tightly sealed steel autoclave. The autoclave was heated in an oven at 180 ºC for 24 hours. After hydrothermal treatment, the product was washed and collected by ethanol and centrifuge.

Measurement of surface area: Brunauer-Emmett-Teller (BET) adsorption isotherms, measured using Kr gas at 78 K, were used to determine sample surface areas. The system for BET measurements consisted of a dosing chamber with an inner volume of 1.72 cm^3 and the sample chamber with an inner volume of 9.00 cm^3. Measurements were carried out by dosing a known amount of Kr gas into the dosing chamber and allowing that gas to expand into the sample chamber. The 2 cm^3 section of the sample chamber where the sample sat was surrounded by a Dewar flask containing liquid nitrogen. After equilibrium was reached between the gas and the sample, the corresponding pressure was recorded and the procedure repeated with a new dose of Kr. The surface area was calculated from the slope and intercept of the corresponding linearized BET isotherm at relative pressures between 0.05 and 0.3. The measured surface area is 28, 32, 8, and 23 $m^2\,g^{-1}$ for S-nanoplates, L-nanoplates, combustion prepared ceria, and hydrothermal treatment prepared ceria spheres, respectively.

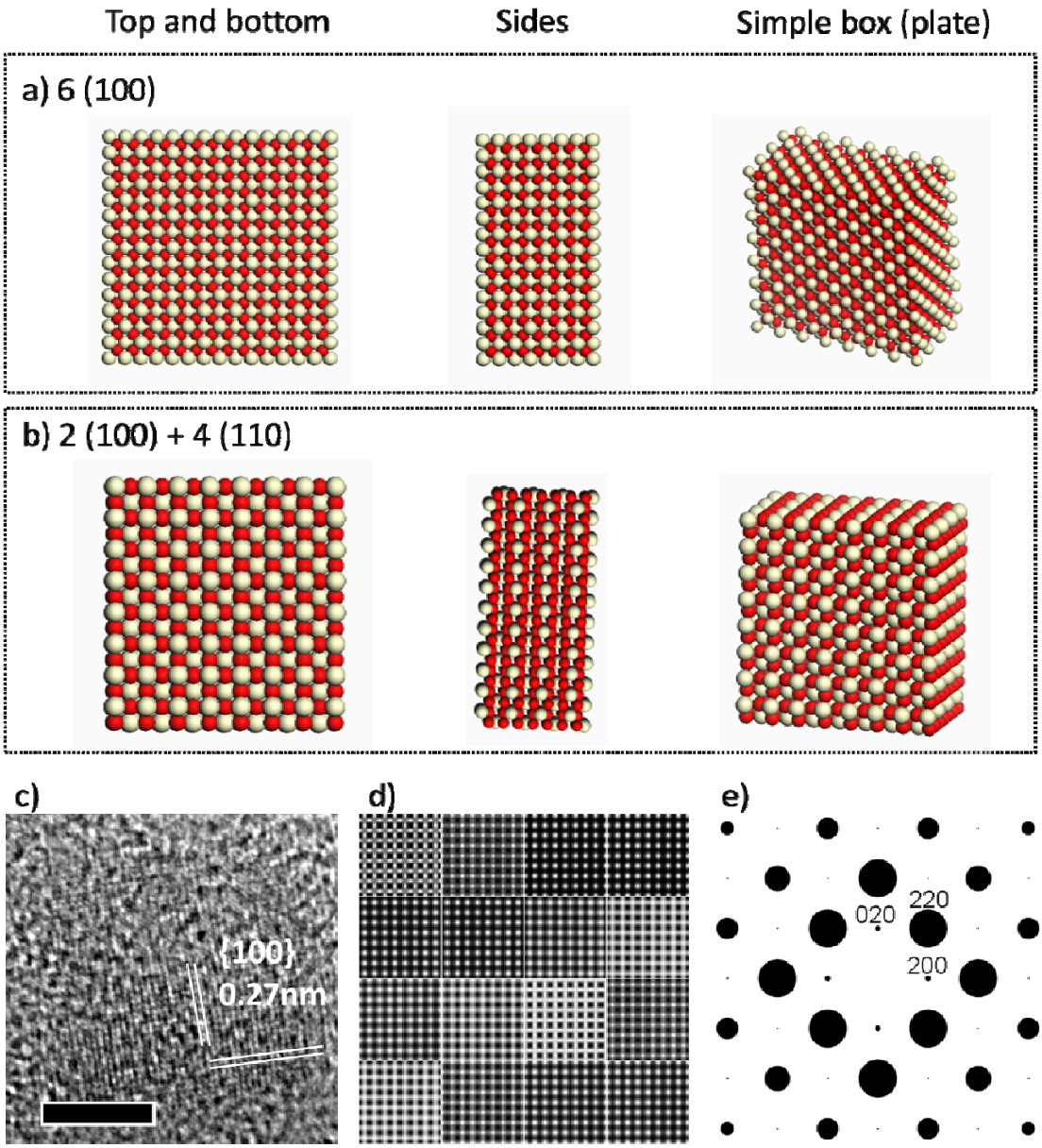

Figure S1. A ceria plate (simple box) having a fluorite unit cell could be enclosed by a) six (100) facets, or b) two (100) facets and four (110) facets. c) HRTEM image (scale bar: 5nm) of ceria nanoplate shows lattice fringes parallel or perpendicular to the edges of plate, implying the agreement with patterns shown in Figure S1a rather than S1b. d) Simulated HRTEM images of [001] zone axis of CeO_2. From left to right and from top to bottom, the defocuses are from 0 nm to -75 nm, with a defocus step of 5 nm. e) Simulated electron diffraction pattern of [001] zone axis of CeO_2. Electron diffraction simulation and HRTEM image simulation were performed with EMS Software (Pierre Stadelmann). Here, the HRTEM image and simulation suggest that the ceria nanoplates should be enclosed by six (100) facets.

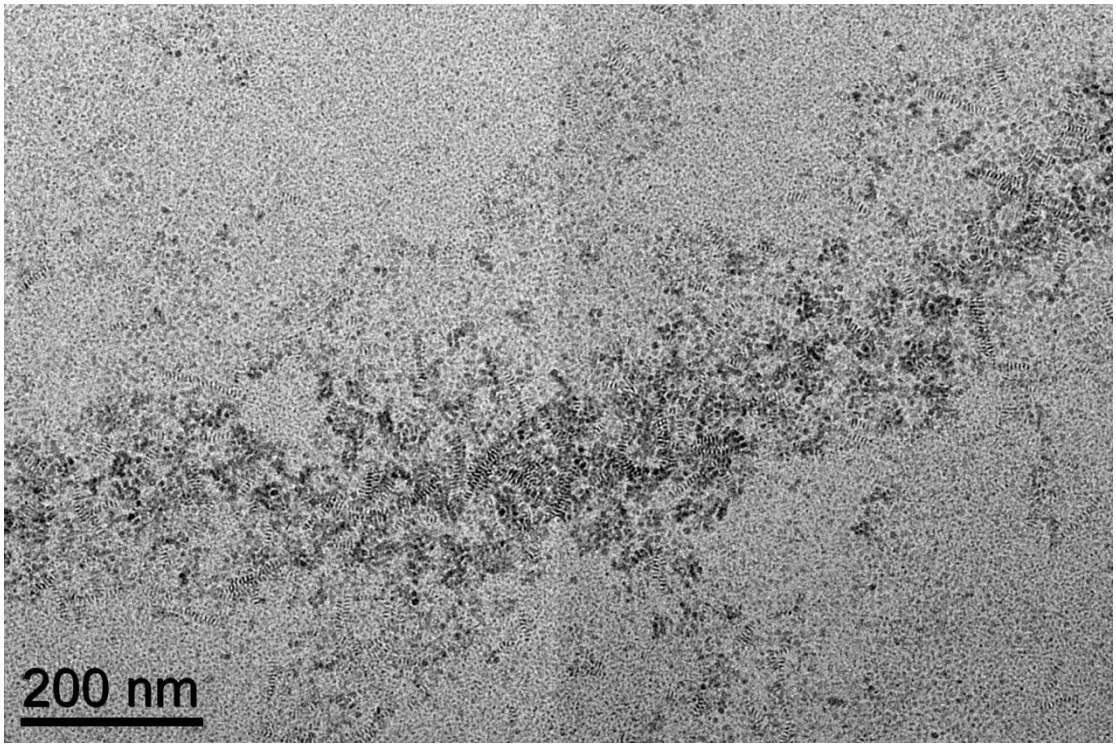

Figure S2. TEM image of the product synthesized in the absence of mineralizers.

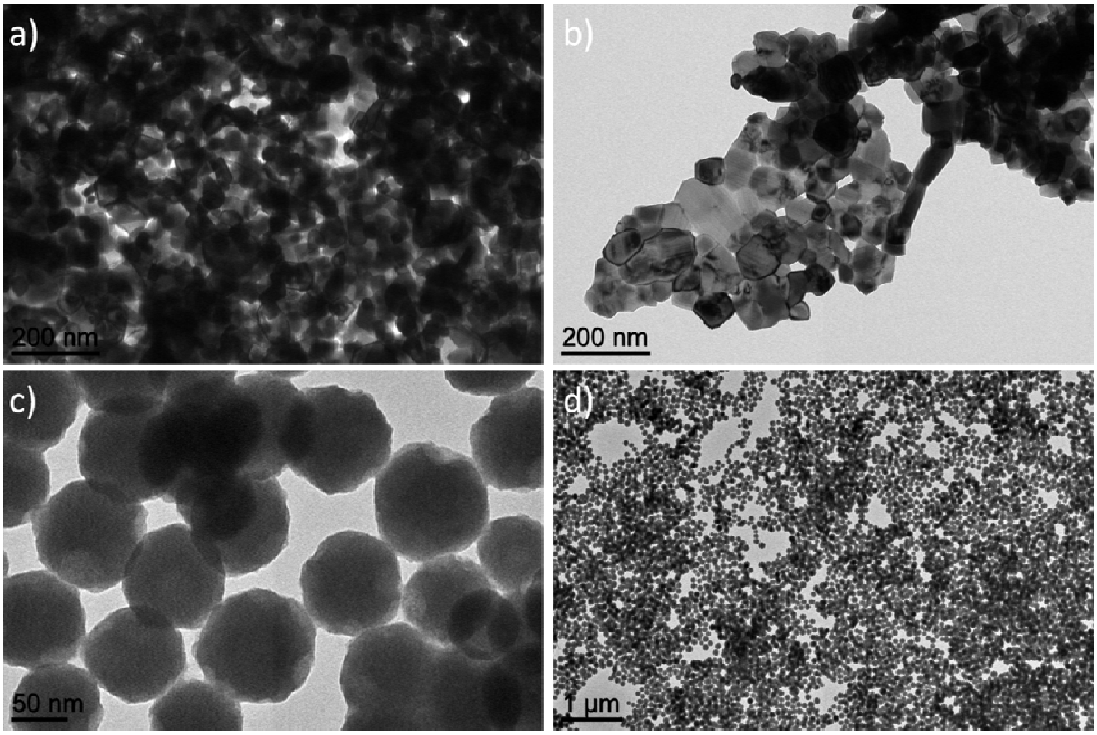

Figure S3. TEM images of a, b) combustion prepared ceria nanomaterials and c, d) hydrothermal treatment prepared ceria nanomaterials (spheres).

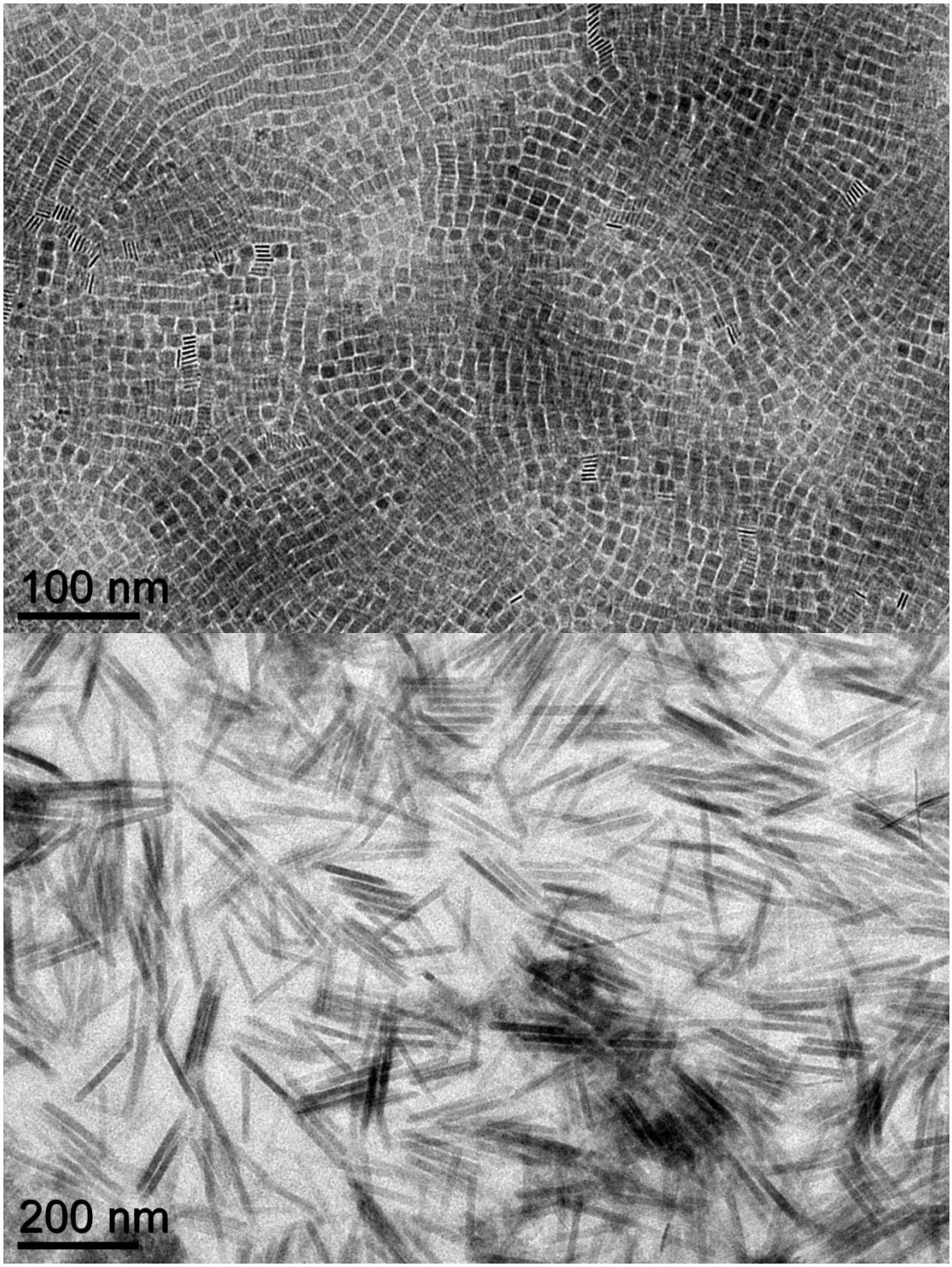

Figure S4. TEM image of the ceria nanoplates heated at 300 ºC.

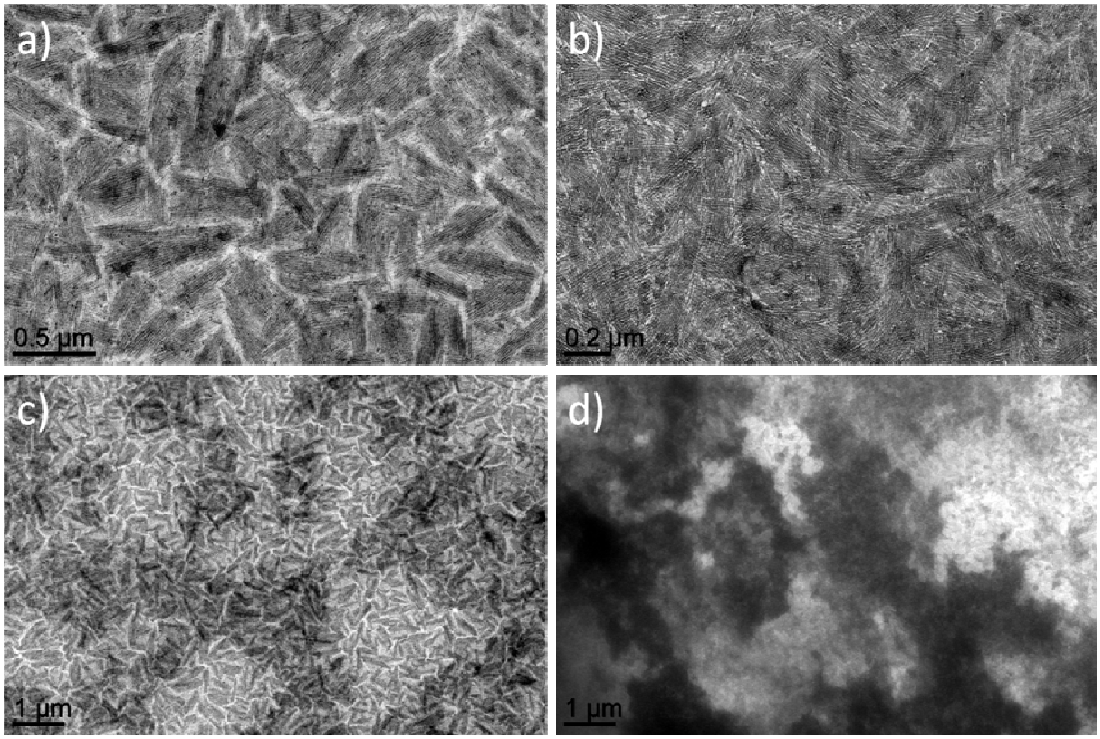

Figure S5. TEM images of the aggregated ceria nanoplates in the form of powder.

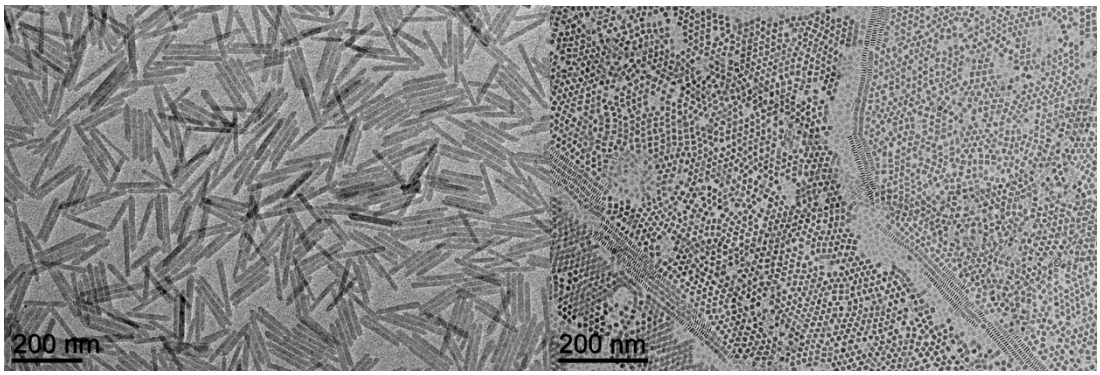

Figure S6. TEM images of ceria nanoplates synthesized under ambient environment (without inert gas protection).

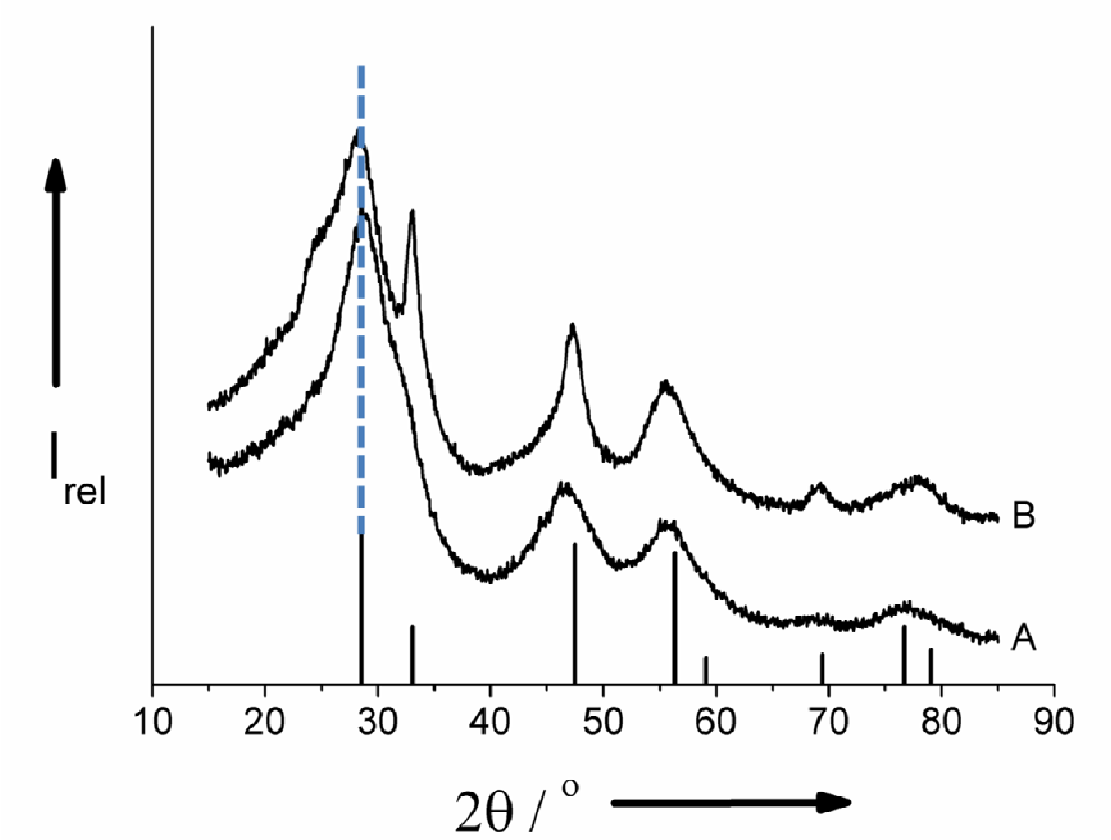

Figure S7. XRD patterns of A) square ceria nanoplates and B) elongated ceria nanoplates.