

## Supporting Information

### **Single Crystal ZrO<sub>2</sub> Nanosheets Formed by Thermal Transformation for Solid Oxide Fuel Cells and Oxygen Sensors**

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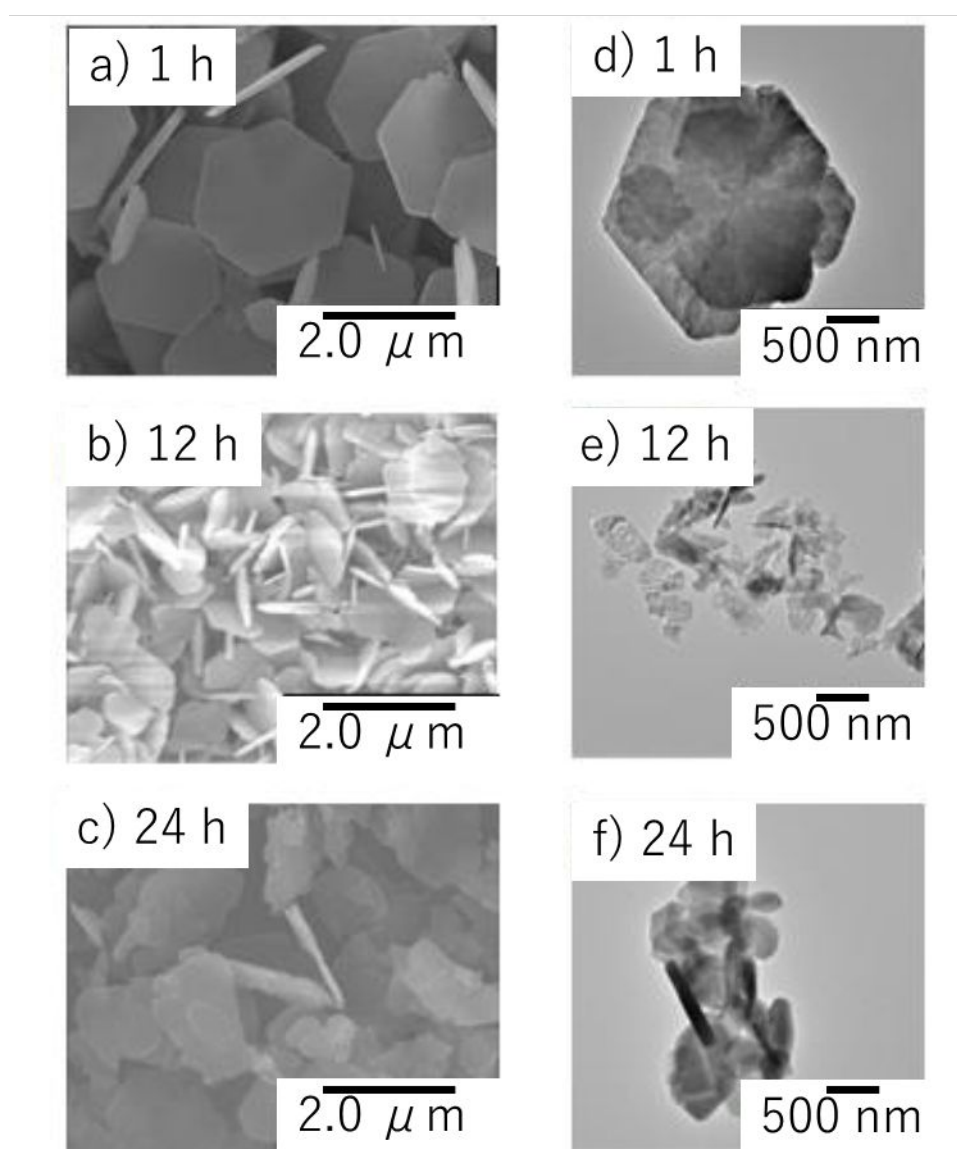
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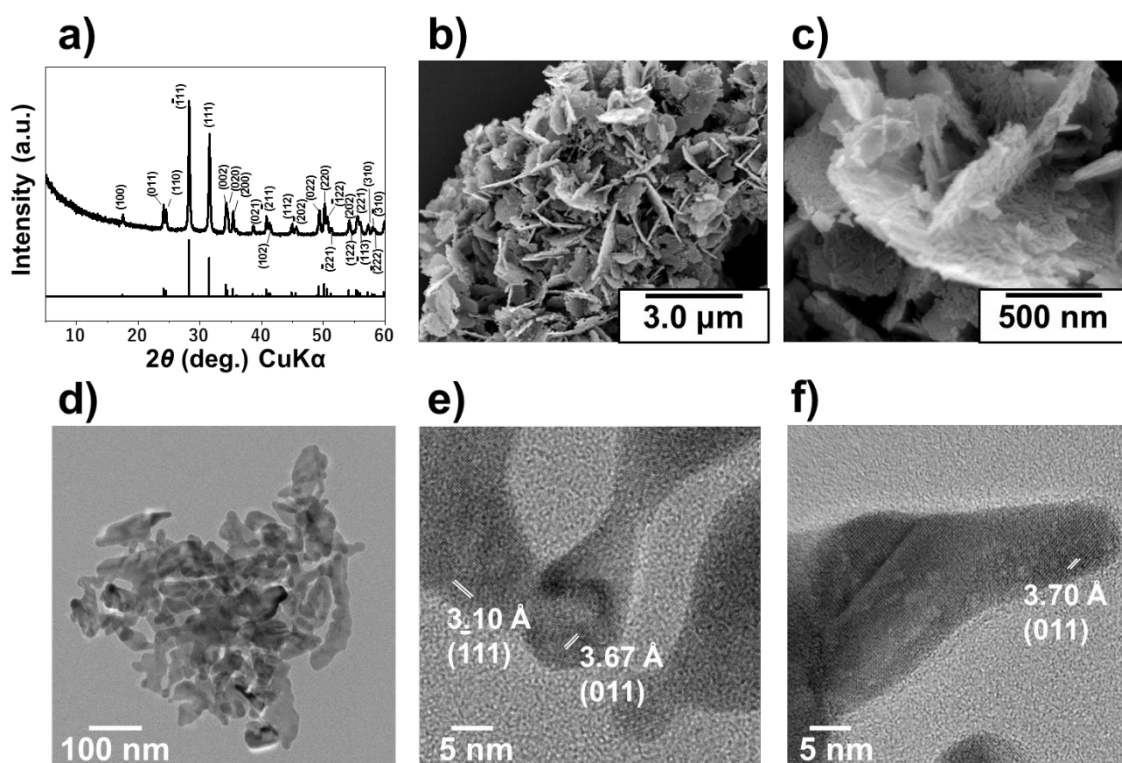
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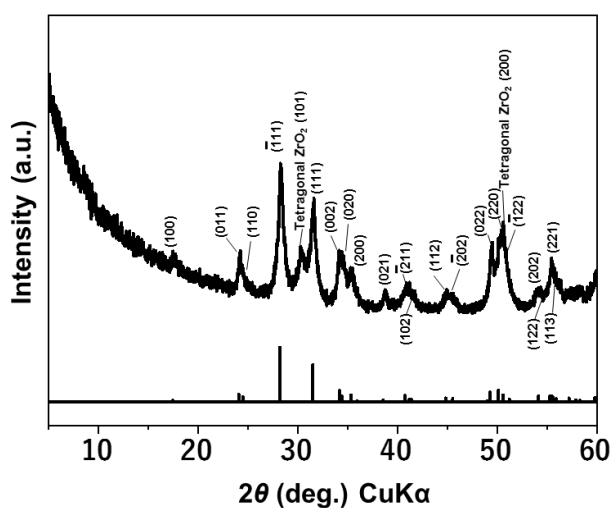
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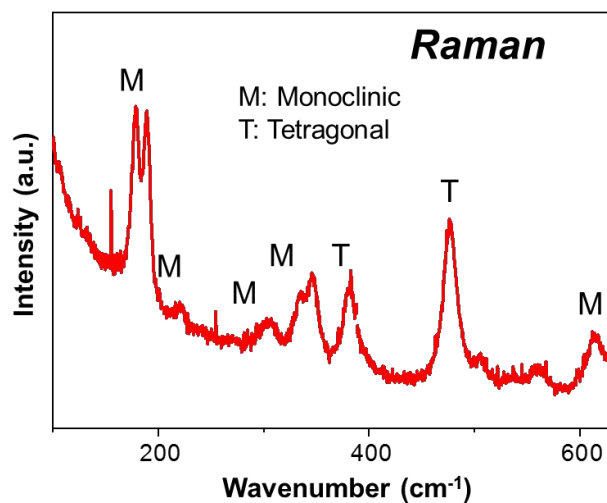
**Figure S1.** SEM images of the samples prepared by ionothermal at different heating time; (a) 1 h (b) 12 h, (c) 24 h. TEM image of of the samples prepared by ionothermal at different heating time; (d) 1 h (e) 12 h, (f) 24 h



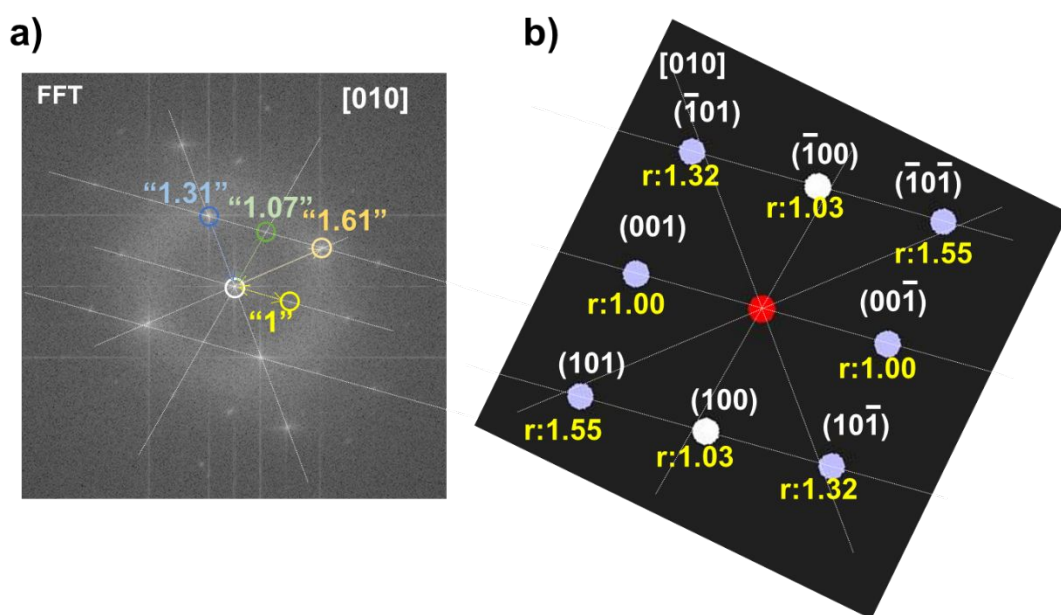
**Figure S2.** a) XRD pattern of  $\text{ZrO}_2$  sample after thermal transformation without ionic liquid, including reference pattern ICDD #01-081-1314; b,c) SEM images of the  $\text{ZrO}_2$  after thermal transformation; d-f) TEM images of the  $\text{ZrO}_2$  after thermal transformation.



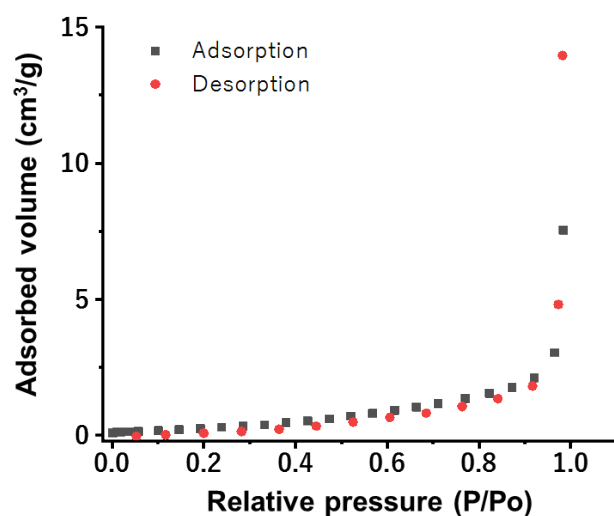
**Figure S3.** XRD pattern of  $\text{ZrO}_2$  sample after thermal transformation in an ionic liquid, including reference pattern ICDD #01-081-1314.



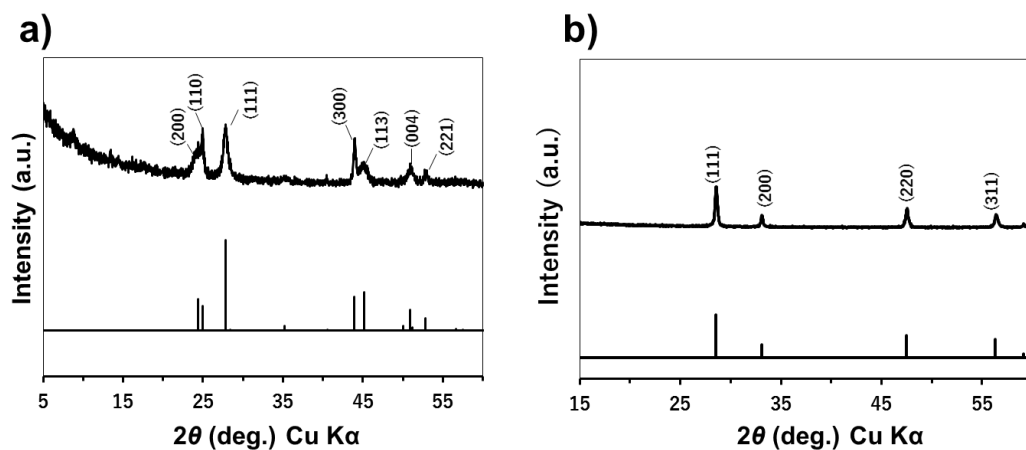
**Figure S4.** Raman spectrum of powder of  $\text{ZrO}_2$  nanosheet. M indicates the peaks attribute to monoclinic phase. T indicates the peak attribute to tetragonal phase.



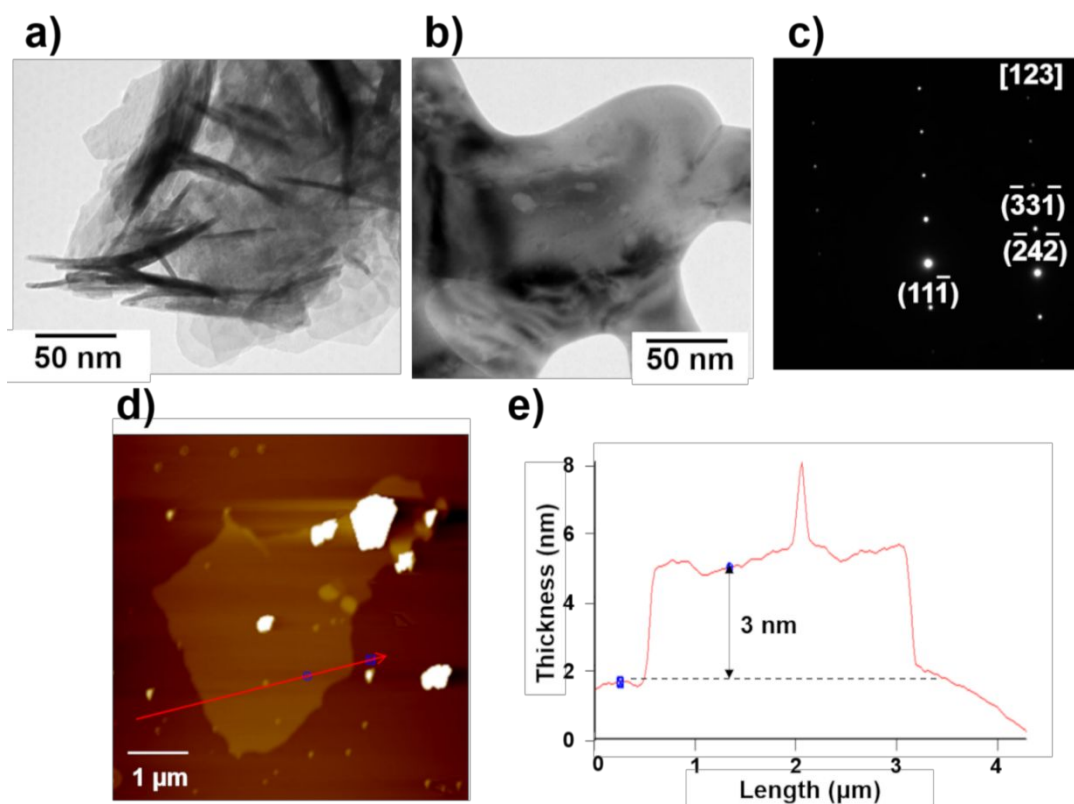
**Figure S5** a) FFT analysis of the Figure 2c; b) The simulated FFT pattern from the direction of  $[010]$ . The  $r$  indicates a relative length from origin defining the distance from the origin to closest spot to be 1.



**Figure S6** Nitrogen physisorption isotherms of  $\text{ZrO}_2$  nanosheets. Adsorbed amounts of gas are measured as a function of relative pressure. The black plots and red plots show the adsorption and desorption, respectively.



**Figure S7** a) XRD pattern of  $\text{CeF}_3$  obtained after ionothermal treatment; b) XRD pattern of  $\text{CeO}_2$  obtained after thermal transformation in ionic liquid. Bottom pattern are references, ICDD # 01-089-1933 ( $\text{CeF}_3$ ) and ICDD # 00-034-0394 ( $\text{CeO}_2$ )



**Figure S8.** a) TEM image of CeF<sub>3</sub> synthesized by ionothermal treatment; b) TEM image of a CeO<sub>2</sub> nanosheet; c) SAED pattern of one CeO<sub>2</sub> nanosheet; d) AFM image of a CeO<sub>2</sub> nanosheet; e) Thickness profile for the direction indicated by the arrow in d).