

### Supporting information

## Experimental demonstration of necessary conditions for X-ray induced synthesis of cesium superoxide

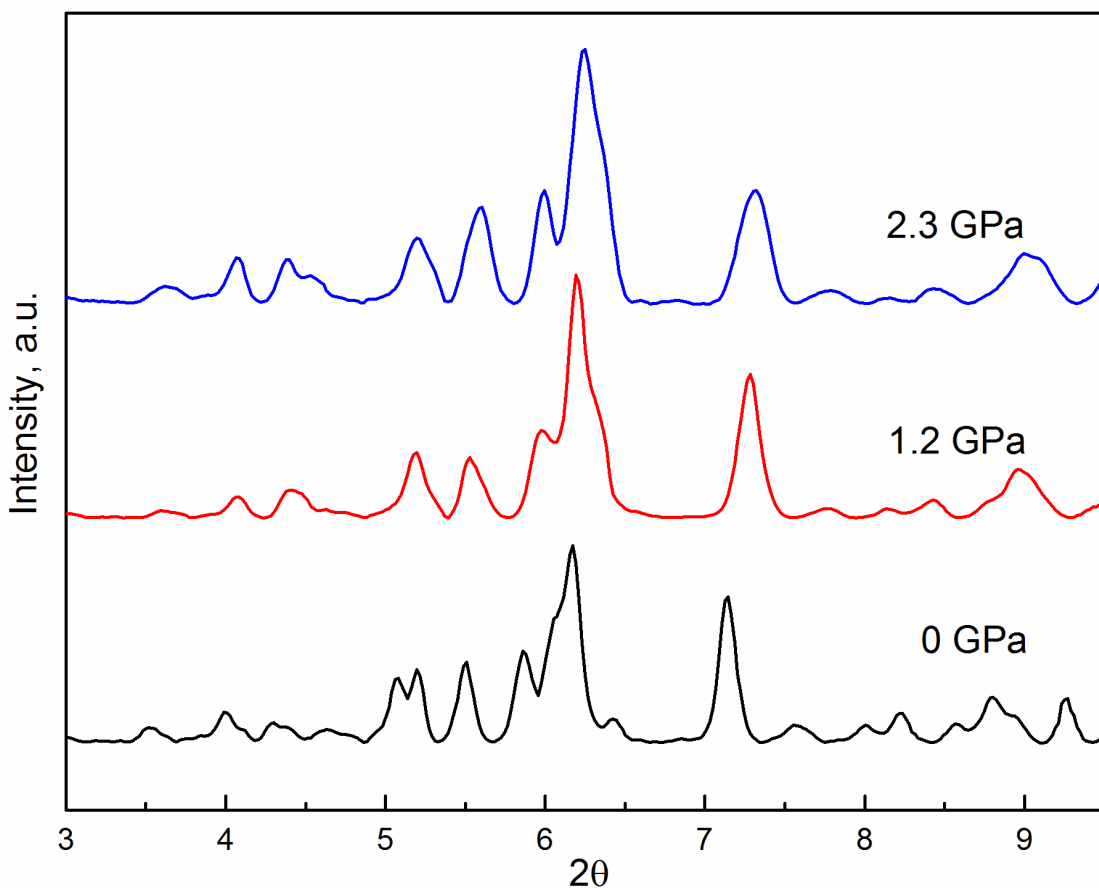
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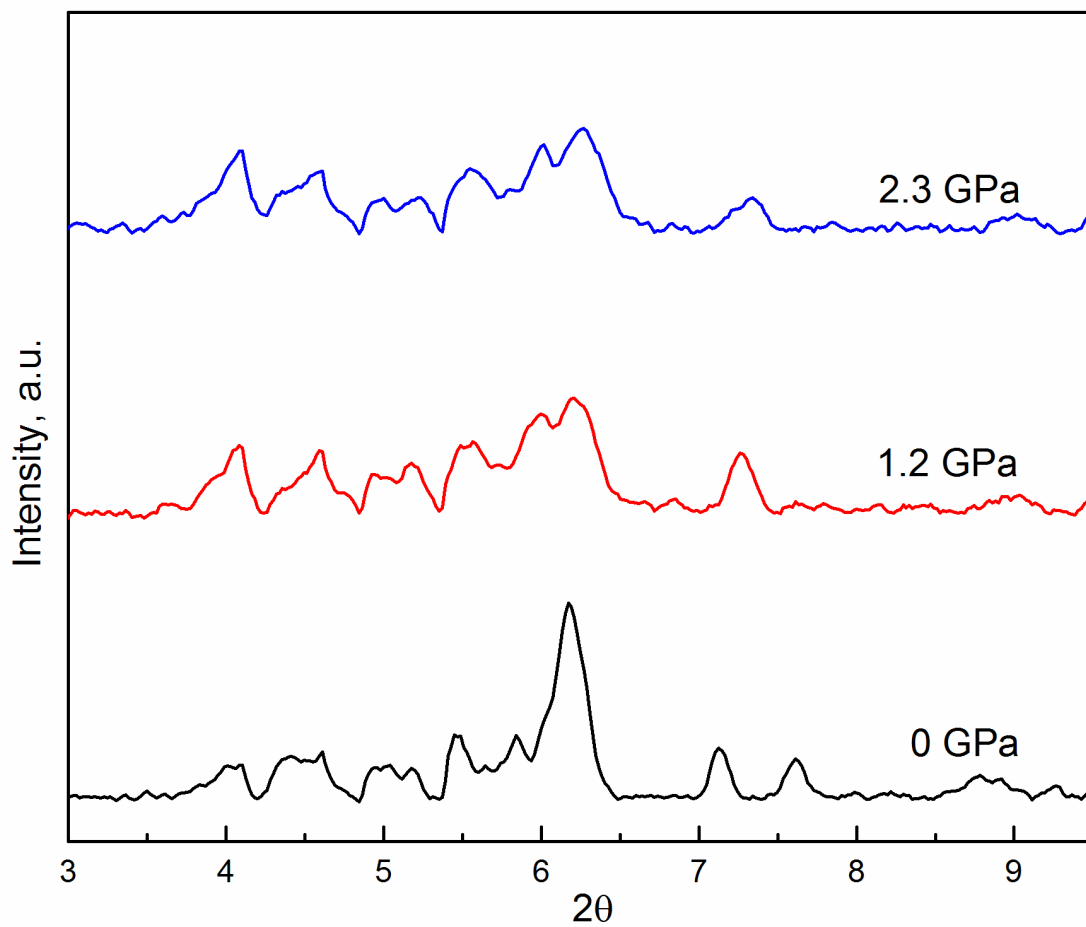
<sup>b</sup>Department of Chemistry and Biochemistry, University of Nevada Las Vegas, Las Vegas, NV 89154, USA

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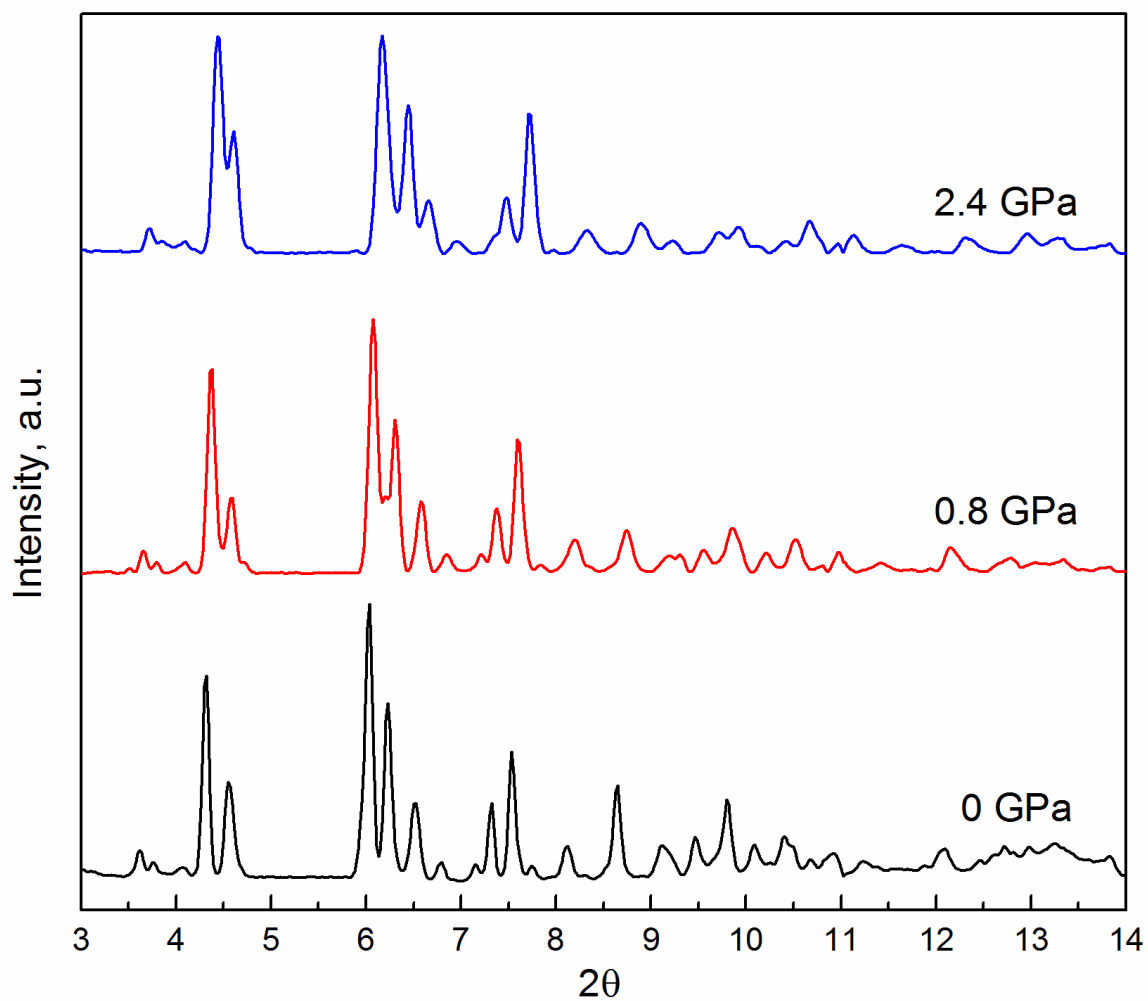
<sup>d</sup>High Pressure Collaborative Access Team (HPCAT), X-Ray Science Division, Argonne National Laboratory, Lemont, IL 60439, USA.



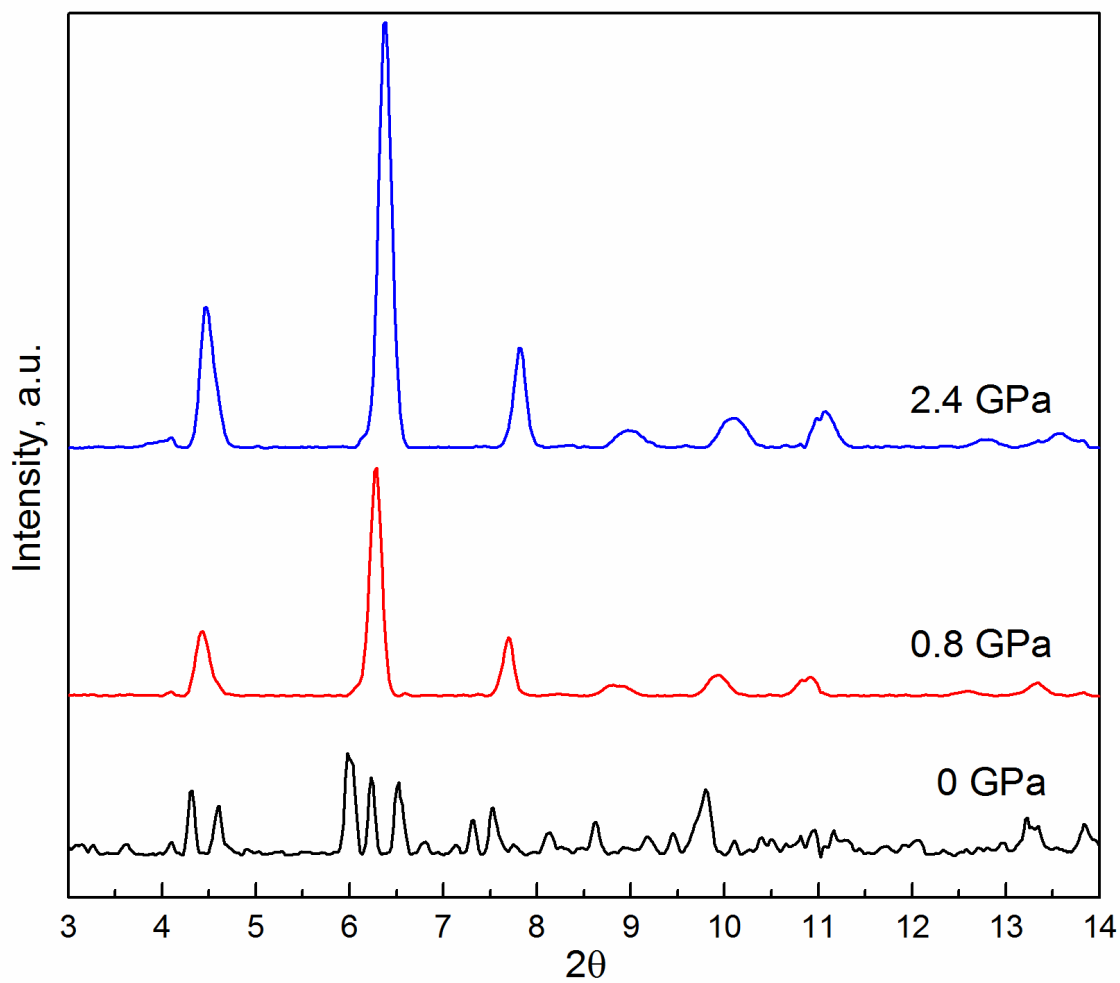
**Figure. S1.** XRD patterns of cesium oxalate (Cs<sub>2</sub>C<sub>2</sub>O<sub>4</sub>) at ambient pressure, 1.2 GPa and 2.3 GPa after 1 min of X-ray irradiation at 36 keV.



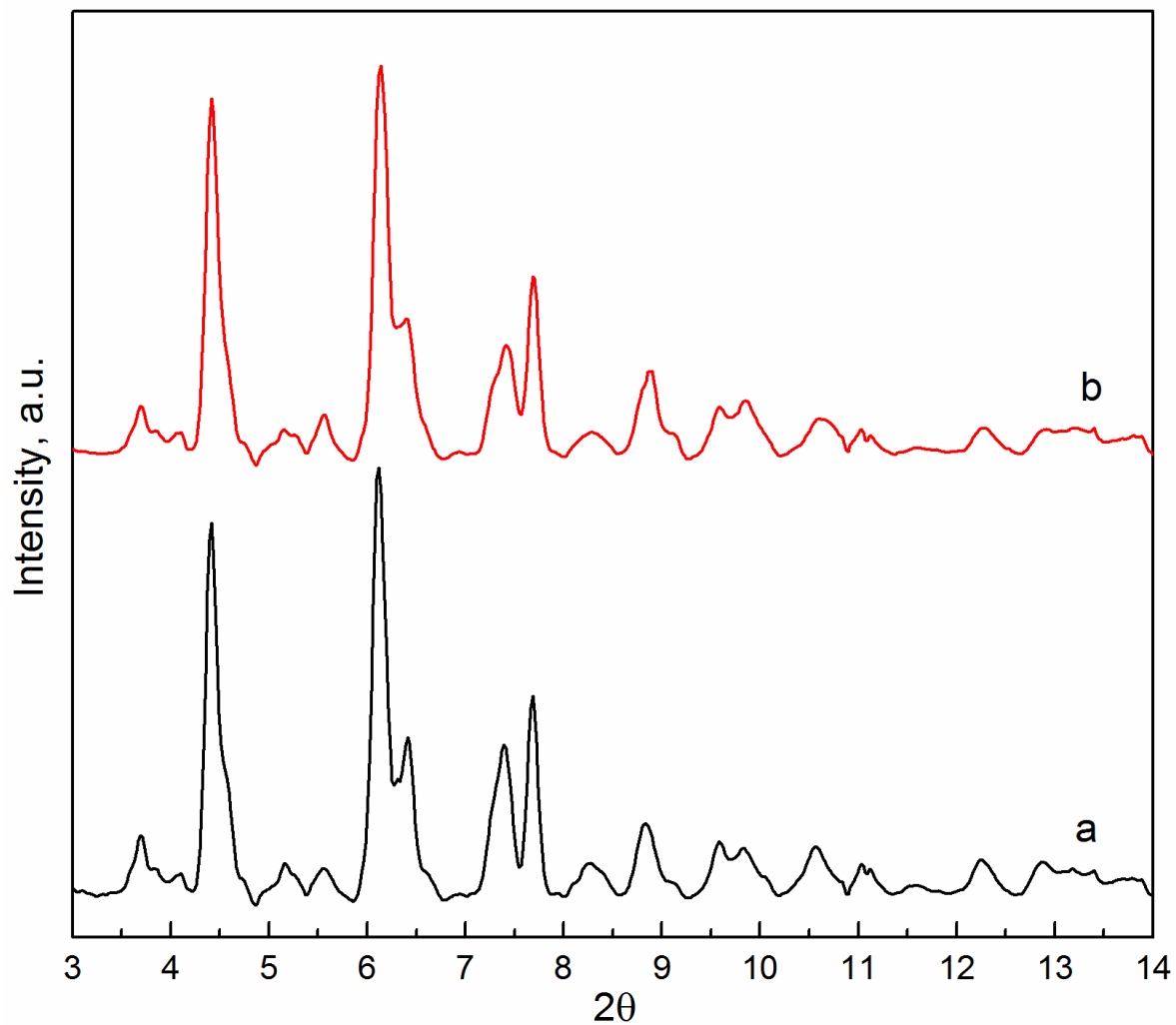
**Figure S2.** XRD patterns of cesium oxalate ( $\text{Cs}_2\text{C}_2\text{O}_4$ ) at ambient pressure, 1.2 GPa and 2.3 GPa after 60 min of X-ray irradiation at 36 keV.



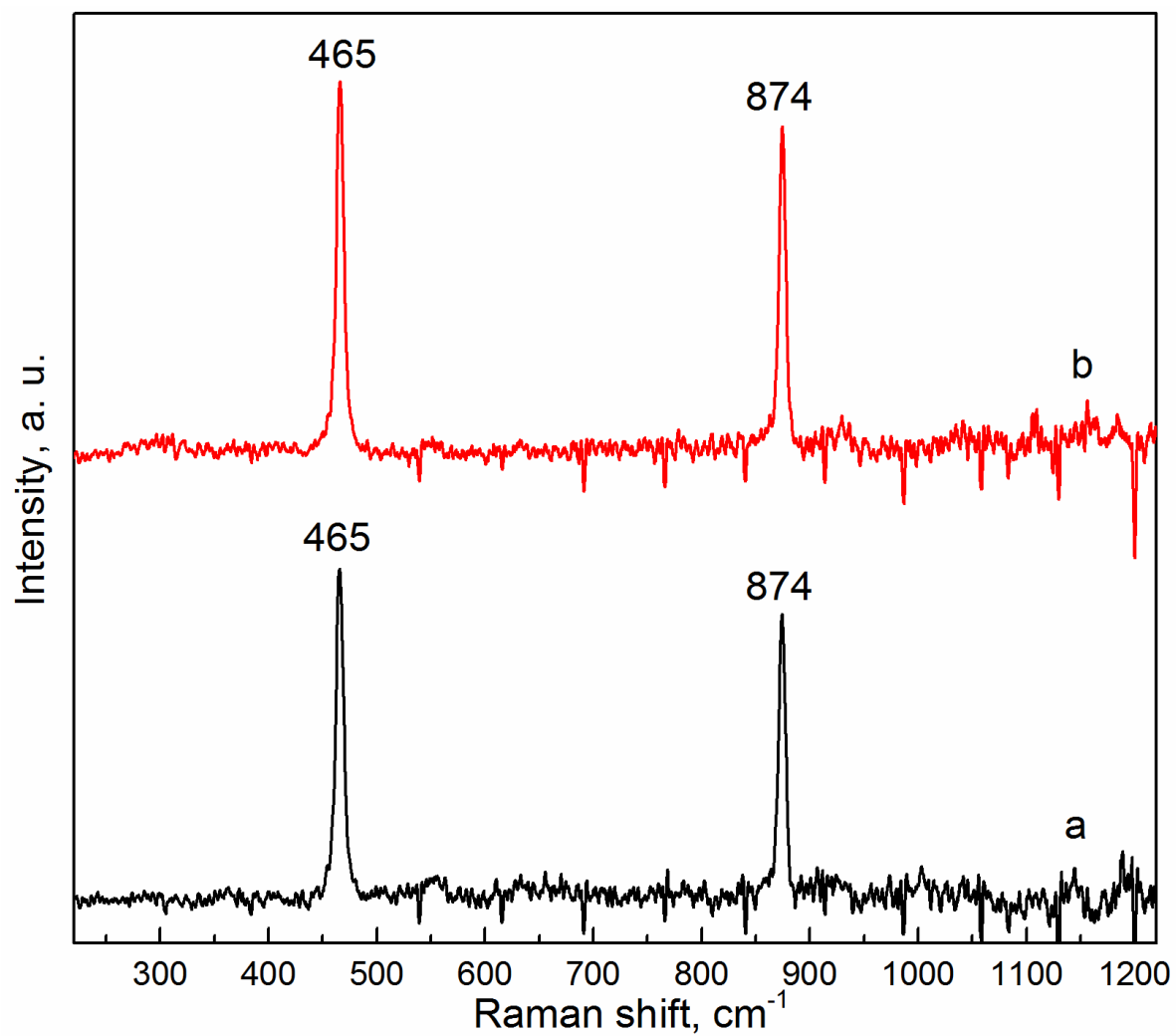
**Figure S3.** XRD patterns of cesium oxalate monohydrate ( $\text{Cs}_2\text{C}_2\text{H}_2\text{O}_5$ ) at ambient pressure, 0.8 GPa and 2.4 GPa after 1 min of X-ray irradiation at 36 keV.



**Figure S4.** XRD patterns of cesium oxalate monohydrate ( $\text{Cs}_2\text{C}_2\text{H}_2\text{O}_5$ ) at ambient pressure, 0.8 GPa and 2.4 GPa after 60 min of X-ray irradiation at 36 keV.



**Figure S5.** XRD patterns of cesium oxalate monohydrate ( $\text{Cs}_2\text{C}_2\text{H}_2\text{O}_5$ ) at 2 GPa: (a) after 1 min of X-ray irradiation at 36 keV and (b) after following 60 min without X-ray irradiation.



**Figure S6.** Raman spectra of cesium oxalate monohydrate ( $\text{Cs}_2\text{C}_2\text{H}_2\text{O}_5$ ) at 2 GPa: (a) initially loaded sample in a DAC and (b) after following 60 min under pressure.