

**Supplementary Material**  
**for**  
**Engineering disorder at a Nano-scale: A Combined TEM**  
**and XAS investigation of Amorphous vs. Nano-crystalline**  
**Sodium Birnessite**

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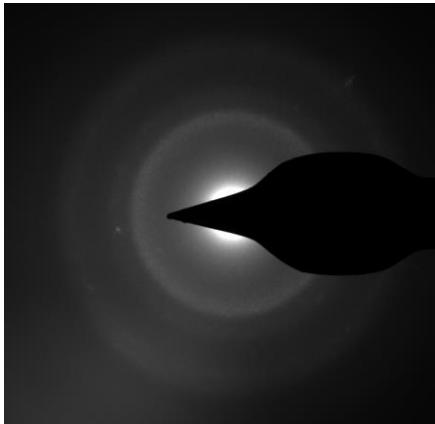
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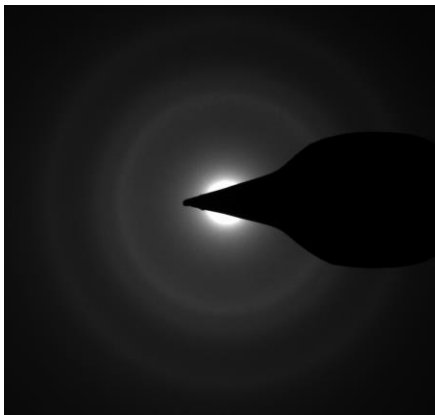
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Made from 400 mM  $\text{Mn}^{2+}$



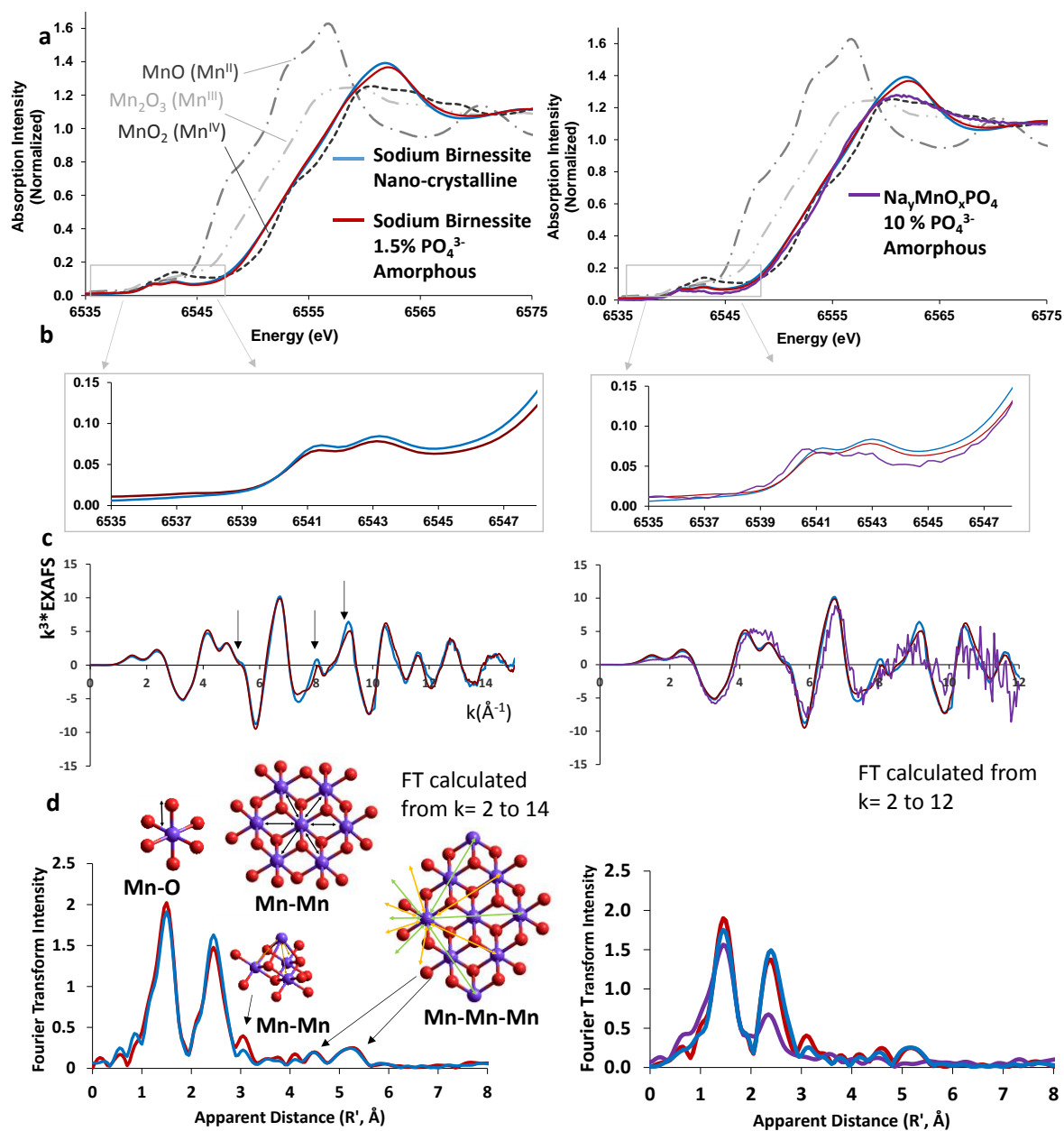
High concentration of  $\text{Mn}^{2+}$ , precipitation occurs faster, less crystalline

Made from 40 mM  $\text{Mn}^{2+}$

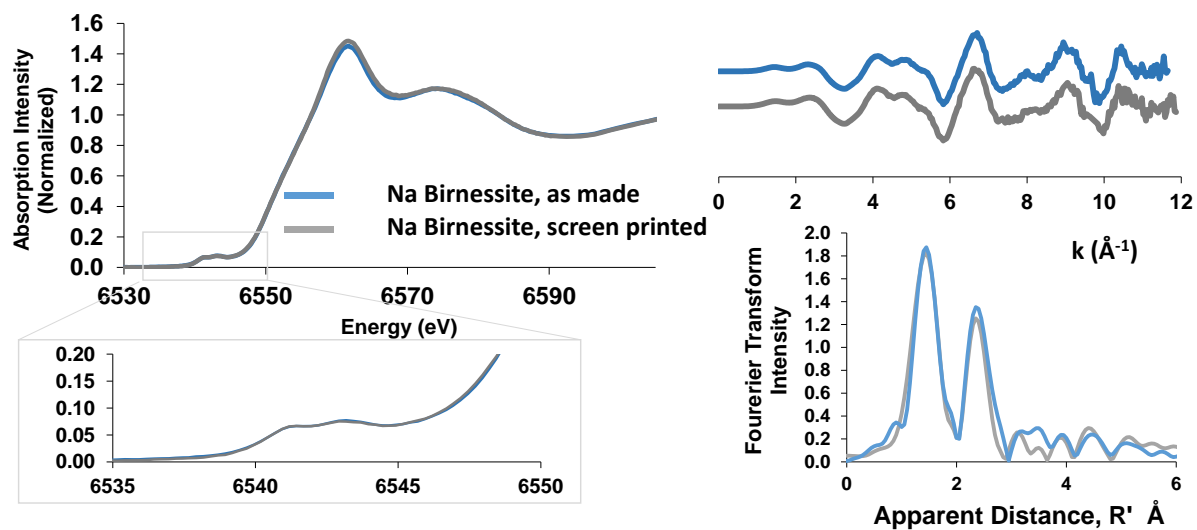


Lower concentration of  $\text{Mn}^{2+}$ , precipitation occurs slower, more crystalline

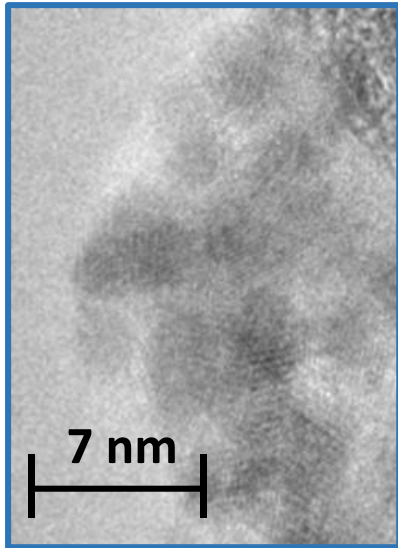
**Figure S1.** HR-TEM selected area electron diffraction patterns taken on materials made a two different Mn concentrations. The diffraction images were taken at a camera length of 230 mm for both.



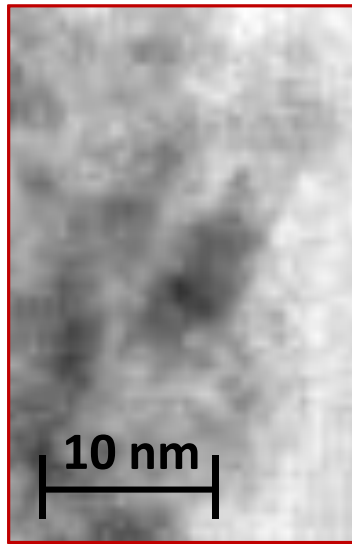
**Figure S2.** Comparison of the data presented in the paper (left) with that with 10 % PO<sub>4</sub><sup>3-</sup> reported.(right)



**Figure S3.** Comparison of the XAS data taken on the sodium birnessite bulk material and the material after screen printing.

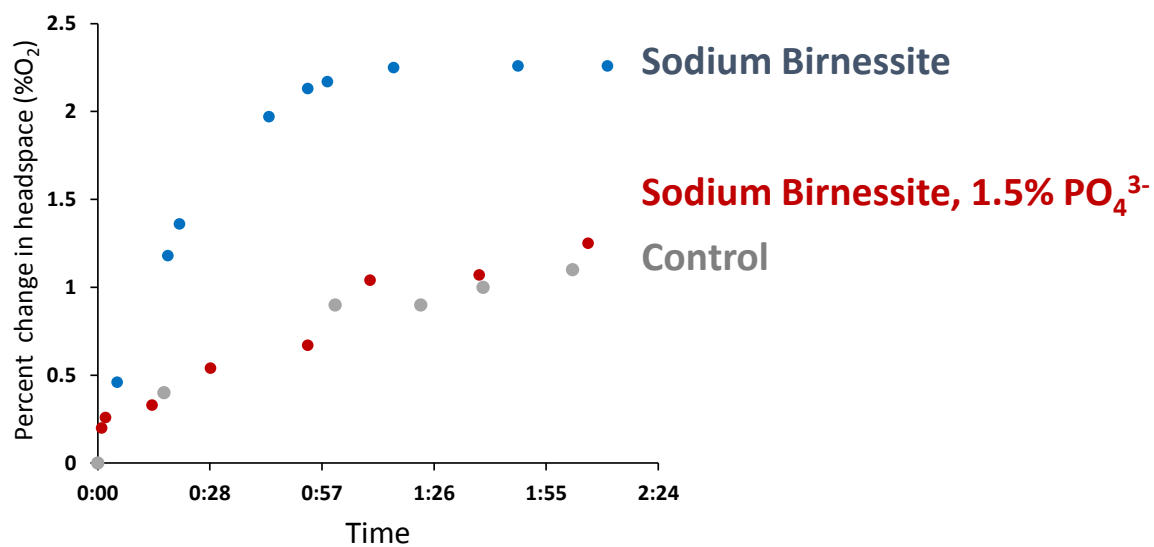


**A. Sodium Birnessite**



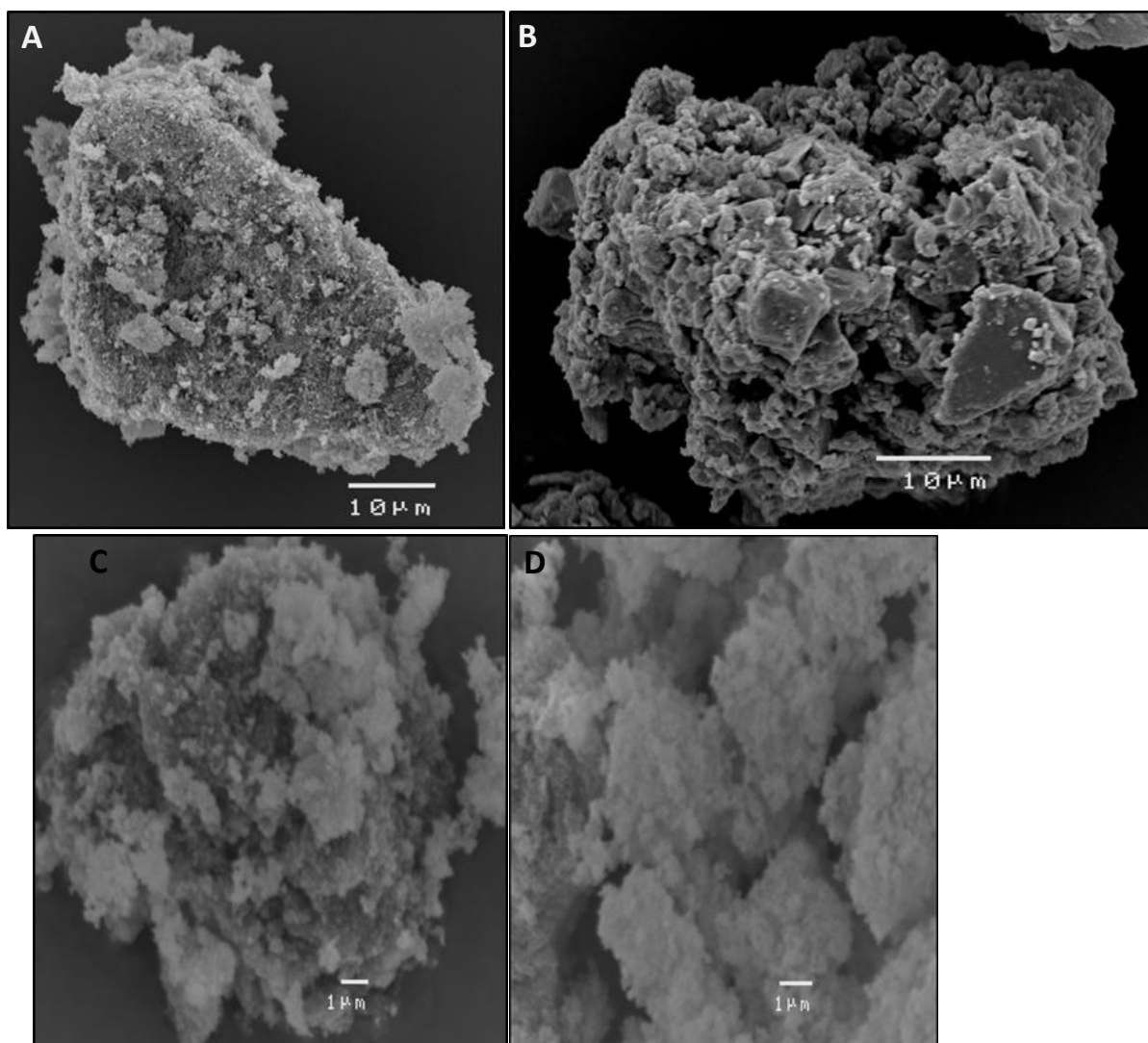
**B. Sodium Birnessite  
co-precipitated with  
1.5% Phosphate**

**Figure S4.** HR-TEM Images comparing sodium birnessite (left) with sodium birnessite 1.5% Phosphate doped (right) as screen printed.



**Figure S5.** Percent change in O<sub>2</sub> concentration (as % O<sub>2</sub>) plotted over time after the addition of oxone to 0.05g of MnO<sub>x</sub> material.

**Scanning Electron Microscopy:** Samples were ground to a fine powder and Au sputter-coated. The Scanning Electron Microscopy (SEM) analysis was conducted with a Jeol JSM5410LV scanning microscope at 25 kV. Samples were analysed at a scale of 1-100  $\mu\text{m}$ .



**Figure S6.** SEM images of Na-birnessite, A. control made with 40mM Mn(II); B. phosphate doped made with 40mM Mn(II) (10%); C. Control sodium birnessite made with 400mM Mn(II) D. phosphate doped 400mM Mn(II) (1.5%).