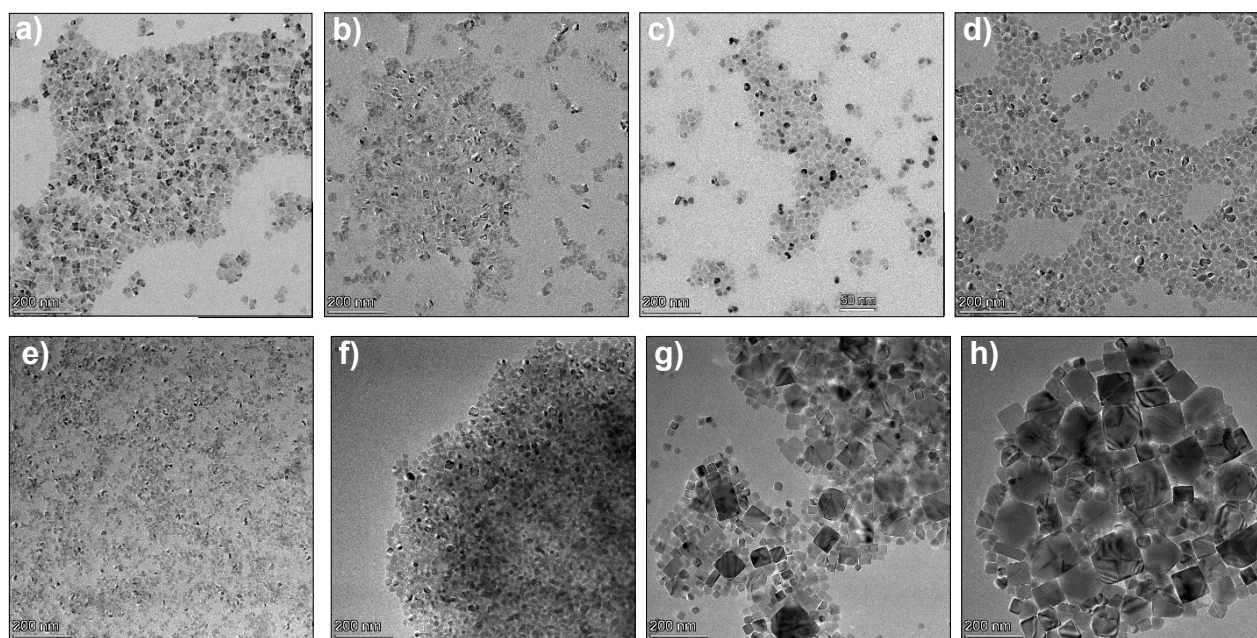
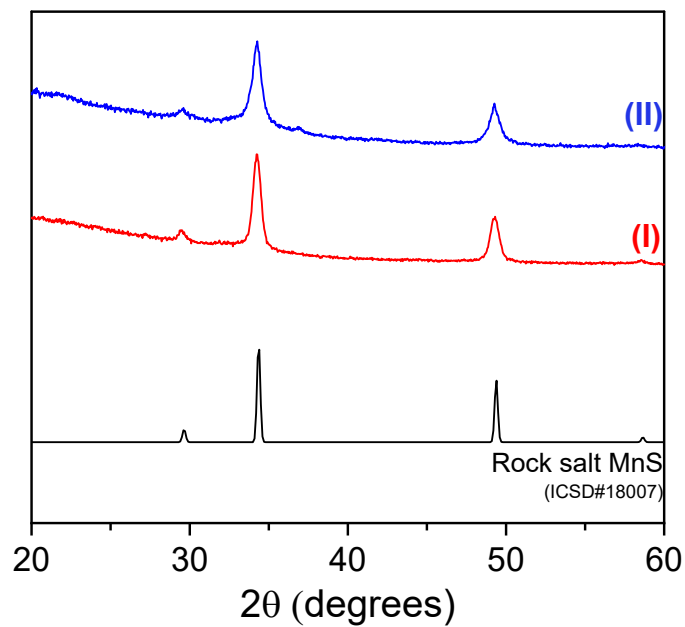


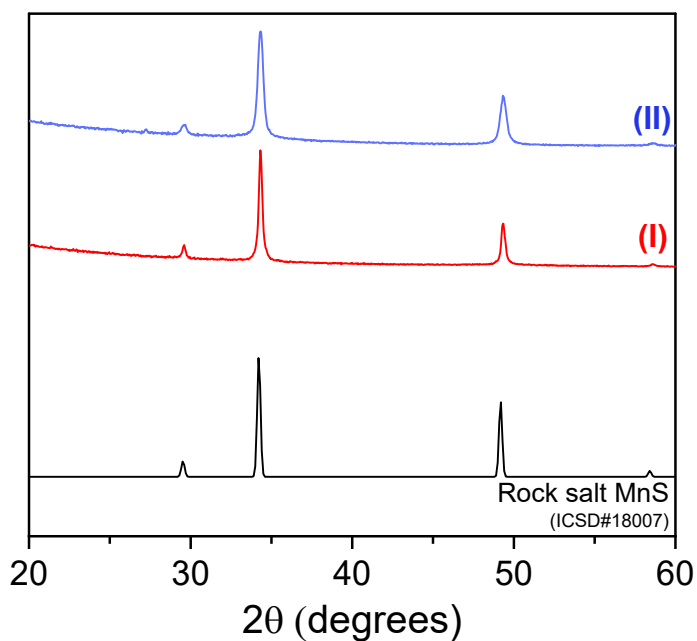
**Figure S1.** XRD pattern collected after reaction of  $\text{MnF}_2$  and S in OLAM showing the unreacted precursor.



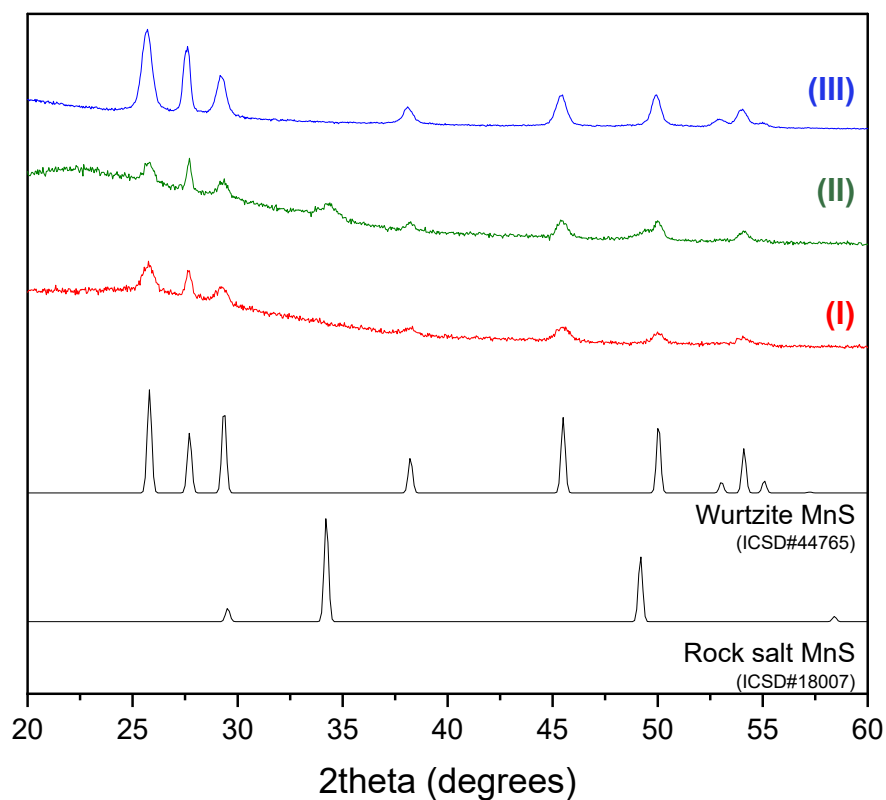
**Figure S2.** TEM images collected for aliquots taken at 205 °C (a,e), 240 °C 0 minutes (b,f), 240 °C 30 minutes (c,g), and 240 °C 60 minutes (d, h) for MnS particles synthesized from  $\text{MnBr}_2$  (a-d) and  $\text{MnI}_2$  (e-h). The aliquots suggest different growth modes based on the halide precursors. Scale bars for full size images is 200 nm, inset images have scale bar of 50 nm.



**Figure S3.** XRD patterns for the reactions of 0.5 mmol (I) and 2.0 mmol (II)  $\text{MnBr}_2$  while holding the concentration of the sulfur precursor at 1.0 mmol as in the stoichiometric reaction.



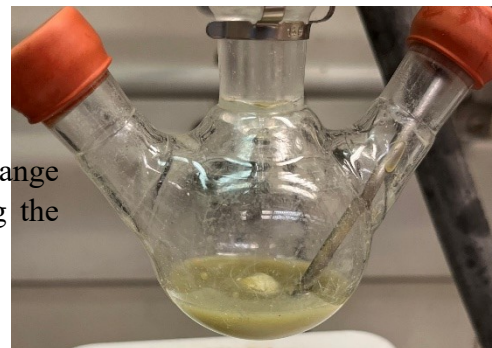
**Figure S4.** XRD patterns for the reactions of 0.5 mmol (I) and 2.0 mmol (II)  $\text{MnI}_2$  while holding the concentration of the sulfur precursor at 1.0 mmol as in the stoichiometric reaction.



**Figure S5.** XRD patterns for the reactions 0.5 mmol  $\text{MnCl}_2$  (I,II) and 2.0 mmol (III)  $\text{MnCl}_2$  and 1.0 mmol sulfur precursor. (I) shows particles from an aliquot taken at 1 hour at 240 °C of the reaction with 0.5 mmol  $\text{MnCl}_2$ , (II) shows the final product of the reaction with 0.5 mmol  $\text{MnCl}_2$  and (III) shows the final product of the reaction with 2.0 mmol  $\text{MnCl}_2$ .



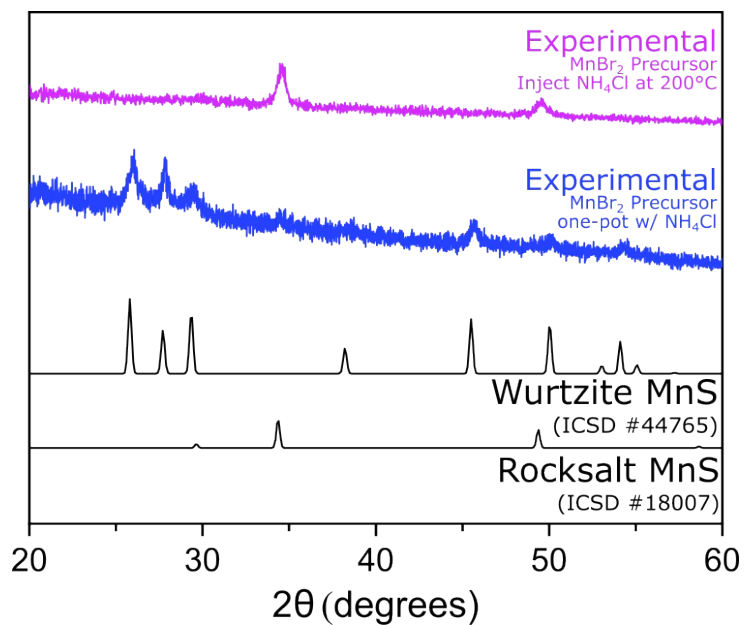
**Figure S6.** Pictures depicting the color change (left to right) from orange to green during the



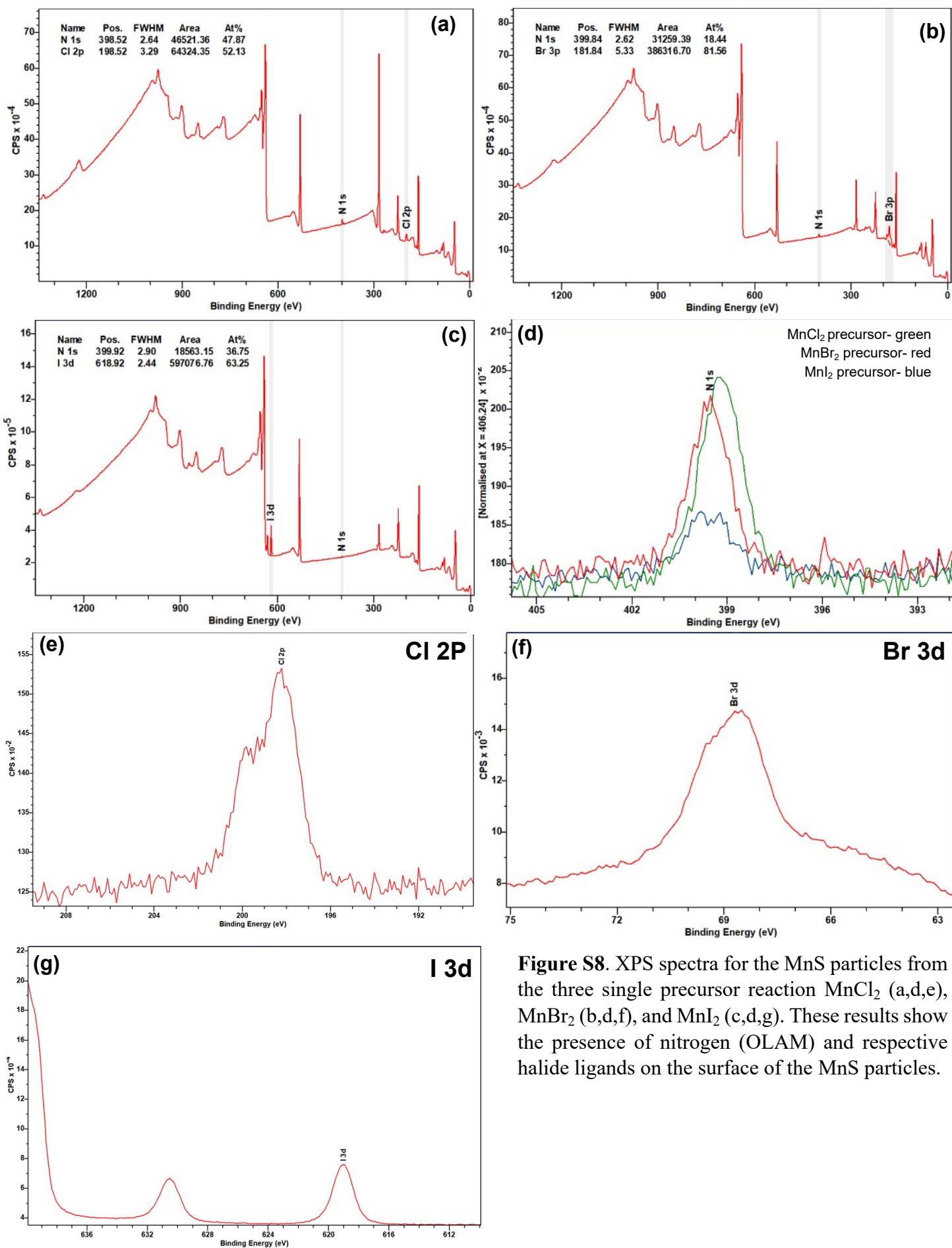
cooling of the reaction of 0.5 mmol  $\text{MnCl}_2$ . The orange color is indicative of the wurtzite structure while the green color corresponds to the rock-salt structure.



mmol  $\text{MnCl}_2$ . The orange color is indicative of the wurtzite structure while the green color corresponds to the rock-salt structure.



**Figure S7.** XRD patterns collected from reaction of MnBr<sub>2</sub> and S in OLAM with surrogate-chloride (NH<sub>4</sub>Cl) in a one-pot reaction (bottom/blue) and injected at 200 °C (top/magenta).



**Figure S8.** XPS spectra for the MnS particles from the three single precursor reaction MnCl<sub>2</sub> (a,d,e), MnBr<sub>2</sub> (b,d,f), and MnI<sub>2</sub> (c,d,g). These results show the presence of nitrogen (OLAM) and respective halide ligands on the surface of the MnS particles.

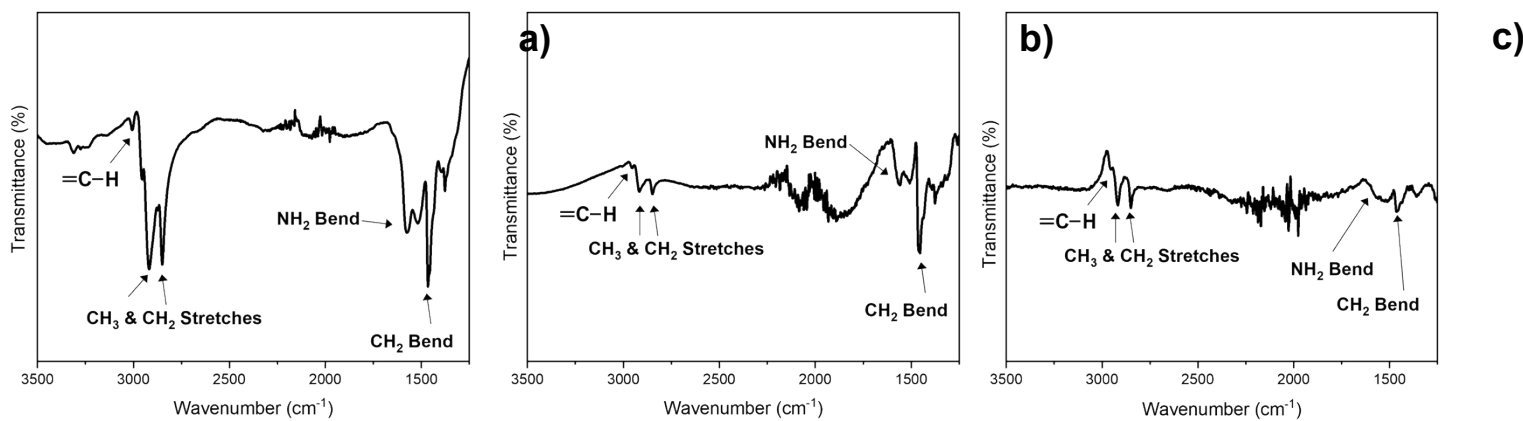


Figure S9. FTIR spectra collected for MnS particles synthesized from (a)  $\text{MnCl}_2$ , (b)  $\text{MnBr}_2$ , (c)  $\text{MnI}_2$ . This demonstrates further the presence of OLAM on the surface of the MnS particles.

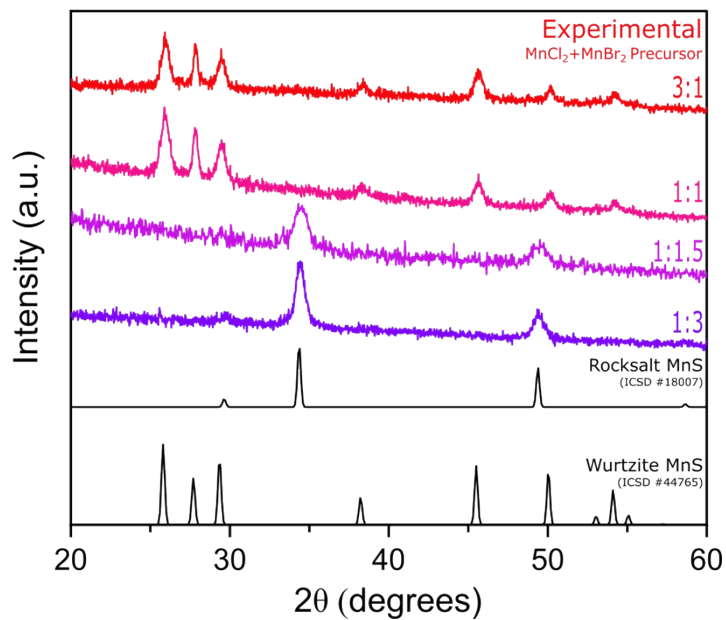
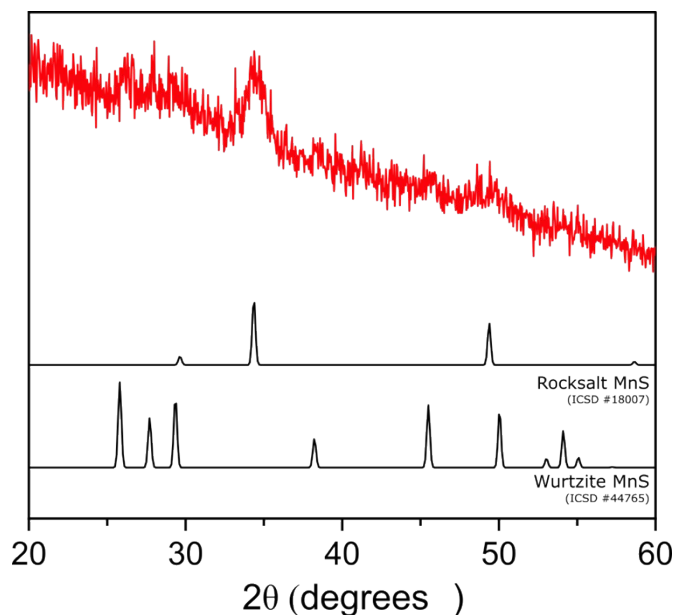
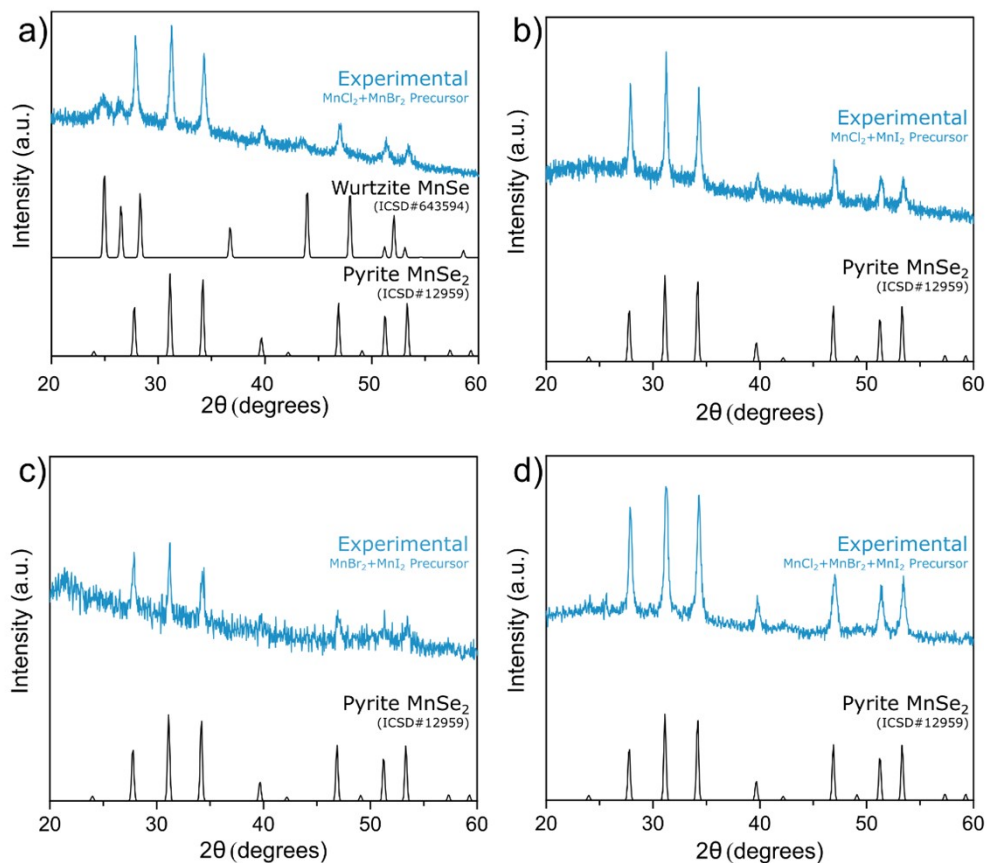


Figure S10. XRD patterns collected for the product from reactions of  $\text{MnCl}_2$  and  $\text{MnBr}_2$  at different ratios with S in OLAM injected after precursors had fully dissolved.





**Figure S11.** XRD pattern collected for the product of the reaction of  $\text{MnCl}_2$  and  $\text{MnBr}_2$  in a 1:1 ratio with the injection of S in OLAM occurring as soon as the reaction mixture reached 120 °C.



**Figure S12.** XRD patterns collected from the reactions of mixed halide precursors to form  $\text{MnSe}_x$ .