Site Occupancy and Disorder Effects On $Mg_{1-x}co_xps_3$ Obtained Through Metal Ionexchange Metathesis

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One of the greatest advanced in 2D materials has been the observation of Kitaev physics in α-$RuCl_3$ which arises from the underlying honeycomb lattice. Van der Waals materials posing a honeycomb sublattice have since been explored. Cobalt thiophosphate ($CoPS_3$) has an antiferromagnetic ground state ordering below T_N = 120 K and has been proposed to potentially host Kiteav-type physics. One of the major drawbacks of studying $CoPS_3$ is the long periods of time required to synthesize and the disorders that the honeycomb sublattice accommodates. Here we present a new synthesis approach via solid-state metathesis which considerably reduces the synthesis time. By exploiting the stability of the isostructural $MgPS_3$, we have successfully performed an ion exchange reaction using $CoCl_2$ at different ratios and reported the structural disorder and effects on magnetic properties. In situ synchrotron powder diffraction was analyzed to gain insight into the reaction path of the solid-state metathesis.