Crystal Growth, Structure, and Magnetism of the 2D Equilateral Triangular Lattice Fluorides

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2D triangular lattice (TL), as one of the simplest model systems for geometrically magnetic frustrated lattices, has recently received a lot of attention for investigating the unconventional physical properties. Considering the magnetic exchange interactions and spin orbital coupling, the 3d transition metal elements, introduced into equilateral 2D triangular lattices, are of potential interest.

In this work, we present crystal structure, single crystal growth, and magnetism of previously unreported Ni-based and Co-based equilateral TL fluorides. Millimeter-size single crystals of both materials have been realized via localized spontaneous nucleation method. Based on the results from single crystal X-ray refinements, these two compounds could be considered as structurally perfect "AAA" stacking 2D equilateral TL materials without any site or positional disorder. The distance of the nearest magnetic ions between neighboring 2D magnetic layers (d_{inter}) is about 7.70 Å and is much larger than that in the 2D layers, d_{intra} = 4.60 Å. Weak easy-plane magnetic anisotropy was found for both materials. A sharp peak was observed for Co-version under zero field specific heat measurements around 180 mK, which indicates a magnetic ordering for this material. Interesting, the long-range magnetic ordering and spin frozen features were not found in Ni-version TL materials down to 100 mK, suggesting interesting physics at ultra-low temperatures.