Synthesis and Properties Investigation a High Pure and Crystalize Sample of Quantum Spin Liquid Material Ca10Cr7O28

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Abstract

The $Ca_{10}Cr_7O_{28}$ has been reported as a material that display all the features expected of a quantum spin liquid [1]. The complexity of the structure always produces a secondary CaO phase that does not affect the magnetic properties but does affect the structural properties [2,3]. In this work we present a detailed study of $Ca_{10}Cr_7O_{28}$ without secondary phases, with the report of the correct ratio of starting materials and synthesis method for obtaining a single phase with high crystalline degree. The chemical cation compositional of the sample $Ca_{10}Cr_7O_{28}$ was confirmed using X-ray energy-dispersive spectroscopy (XEDS), an Electron Probe Microanalyzer (EPMA), and inductively coupled plasma optical Emission Spectrometry (ICPOES). Also, the thermo- gravimetric analysis (TGA) result confirms the composition and the chemical stability of the sample. The crystallization degree and real atomic order of our sample are confirmed by HRTEM techniques and TEM experiments result. The structural phase of the sample was characterized using a high-resolution x-ray diffractometer and Thermo diffraction at low and high-temperature measurement. The Rietveld refinement of the high-resolution diffraction pattern together with electron diffraction helped identify the sample and crystal structure and compare the result to recent studies of the compound [2,3], where the crystal structure is compatible with spin liquid character. Our results confirm that, according to D. Gyepesová et al [3], the material presents a rhombohedral symmetry and special group trigonal, hexagonal axes R3C,161 with lattice parameters a=b= 10.7677 and c= 38.0824 Å. In addition, the magnetic properties as well as specific heat and entropy of our sample of $Ca_{10}Cr_7O_{28}$ confirm the spin liquid character of this compound in agreement with similar behavior of the other quantum spin liquid materials, as expected.

References

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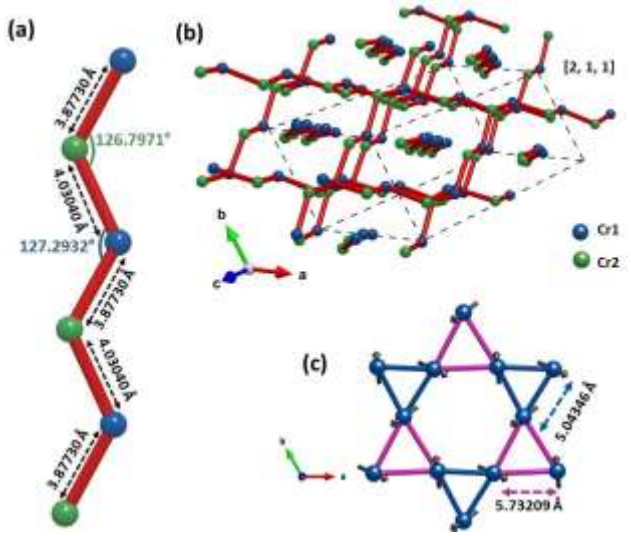

Figure 2: Crystal structure of the material $Ca_{10}Cr_7O_{28}$, (a) Cr1 and Cr2 zig zag chain with distances and angles. (b) Perspective of the zigzag chains along the [211].
(c) Distorted Kagome layer formed by Cr1 atoms with the atomic distances.

Figures

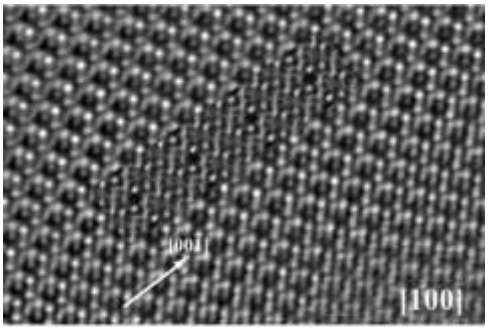

Figure 1: HRTEM image based on Rietveld refinement of the high-resolution diffraction pattern room temperature of the sample.