MAGNETIC STRUCTURE OF $Pb(TiO)Cu_4(PO_4)_4$: ^{31}P, $^{65,63}Cu$ NMR

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Chirality, vortex-like spin-arrangement, broken symmetry, frustration and antiferromagnetic (AFM) ordering provide an excellent environment for the existence of quantum phenomena. The family of tetragonal compounds $A(BO)Cu_4(PO_4)_4$, with (AB = BaTi, PbTi, SrTi, KNb) form layers of four-site "cupola" structures, which are oriented upward and downward. The presence of a quadrupolar moment driven magnetoelectric (ME) effect [1] provides an explicit interest.

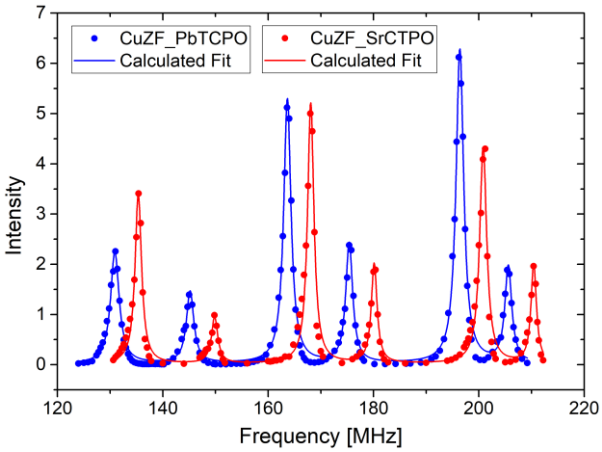

Fig. 1 $^{63,65}Cu$ ZFNMR fitted data of SrTCPO (red dots) and PbTCPO (Blue dots) at liquid He temperature.

We measured the local magnetic environments by ^{31}P, $^{65,63}Cu$ nuclear magnetic resonance (NMR) techniques. These compounds exhibit a phase transition into an AFM ordered state at temperatures below $T_N = 10\,K$. The ^{31}P magnetic shift enabled the characterization of the hyperfine field and positionings of the tensor-type magnetic field at P locations at room temperature, with $H_{\text{int}}^{\text{P}} = 39\text{mT}, 36\text{mT}, 65\text{mT}, 69\text{mT}$ for AB = KNb, BaTi, SrTi, PbTi, respectively. From the $^{65,63}Cu$ zero field NMR (ZFNMR, Fig. 1) we acquired resonant frequencies in ordered state in the locations of Cu^{2+} ions $H_{\text{int}}^{\text{Cu}} = 14.8\text{T}, 14.9\text{T}, 14.5\text{T}, 7.5\text{T}$ for AB = BaTi, SrTi, PbTi, KNb, respectively. The rotating of the crystal in an external magnetic field of $B = 4.7\text{T}$ by ^{31}P NMR showed a more complex structure for PbTCPO at the room temperature but simpler one in the ordered phase compared to BaTCPO[2]. We realized that the growing method created a different domain structure and type of chirality for PbTCPO. The distinct magnetism in KNbCPO showed AFM behavior in magnetic susceptibility and ^{31}P NMR measurements and the $^{65,63}Cu$ ZFNMR at 4.2K was shifted to lower frequency range. Studying these magnetic structures further will contribute to the discovery of novel quantum spin-systems.

References

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