HIGH-FIELD ESR STUDY OF THE 2D SPIN SYSTEM $Ni_5(TeO_3)_4X_2$ (X = Cl, Br)

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Introduction

Low-dimensional quantum spin systems with frustrated geometry have been attracting much attention since the Anderson's conjecture of spin-liquid ground state on a two dimensional (2D) triangular lattice [1]. It is now rather well established that in the case of an isotropic Heisenberg exchange, long-range magnetic ordering (LRO) occurs at $T = 0$ for $S = 1/2$ [2]. The situation becomes considerably richer by introducing larger (integer) spin values, more "complicated" 2D topologies and/or magnetic anisotropy. In such cases, different spin orders as well as exotic quantum-disordered ground states may be realized.

Results and Discussion

Our study focuses on a novel family of 2D compounds [3], $Ni_5(TeO_3)_4X_2$ (X = Cl, Br), in which a triangular-based spin $S = 1$ network, with strongly exchange coupled pairs of spin triangles, is realized [4]. We have already performed a comprehensive magnetic study of these materials; including bulk magnetization and heat capacity measurements as well as some preliminary electron spin resonance (ESR) experiments [4]. The system undergoes antiferromagnetic (AF) LRO at $T_N = 28$ K.

The properties of the lowest-lying magnon modes in the investigated compounds have been inspected through the observation of the antiferromagnetic resonance (AFMR) modes on the homodyne spectrometer (17 T magnet) and the heterodyne spectrometer (14 T magnet) at NHMFL. A frequency-field diagram (Fig. 1) measured with the magnetic field H along the normal to Ni spin planes (a^* direction) reveals that this direction is close to the magnetic easy direction. The zero-field frequency amounts to 470 GHz and 500 GHz for the Cl- and the Br-based compound, respectively, while the zero-field splitting is of 70 GHz and 50 GHz, respectively. This signalizes relatively strong magnetic anisotropy with respect to the dominant isotropic exchange. The angular dependence of the resonance field (Fig. 2) assigns the crystal c axis as the intermediate and b axis as the hard magnetic axis. Numerical simulations of these results, which are currently in progress, should help us to determine the major parameters of the spin Hamiltonian corresponding to the investigated systems.

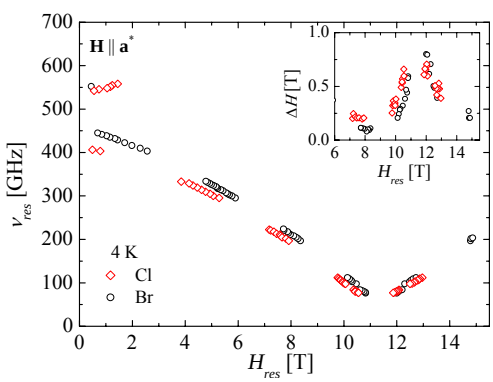

Fig. 1: ν-H diagram of the lowest two magnon modes in $Ni_5(TeO_3)_4X_2$. Inset shows the line-width dependence.

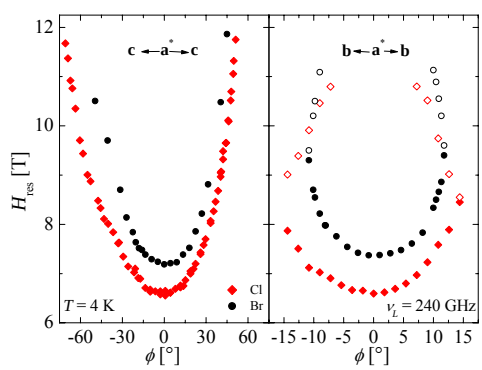

Fig. 2: Angular anisotropy of the resonance field within (a) the ac and (b) the ab crystal plane in $Ni_5(TeO_3)_4X_2$.

Acknowledgements

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References

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