Magnetostriction and Thermal Expansion on 1D Chain Azurite Compound

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Introduction

Azurite is a natural mineral with a chemical structure $Cu_3(OH_2)(CO_3)_2$. This compound is a frustrated triangular quantum magnet consisting of Cu S=1/2 atoms arranged alternately to form infinite chains along the *b* axis. The magnetic behavior of this compound reflects the existence of both monomers and dimers of S = 1/2 Cu. A magnetization plateau at 1/3 of the saturization magnetization is observed in M vs H measurements due to saturization of the monomers. The magnetic structure and the detailed phase diagram in temperature and field are largely unknown or controversial. Recent ultrasound measurements [1] indicate significant magnetoelastic coupling must be taken into account. We have demonstrated that significant, anisotropic magnetostriction occurs in azurite, giving us an indication of the magnetically induced structural distortions.

Experimental

We have studied the magnetostriction effect on azurite using the 33 T resistive magnet available at NHML-Tallahassee. The magnetostriction effect has been detected by the capacitance plate method using a titanium dilatometer. We have demonstrated this technique works well at high fields by sweeping the magnetic field up to 33 T at fixed temperatures between 1.2 and 4.5 K.

Results and Conclusion

We have measured (figure 1) the magnetostriction effect parallel to the direction of the magnetic field for samples mounted with the *b* axis parallel (left panel) or perpendicular (right panel) to the applied field.

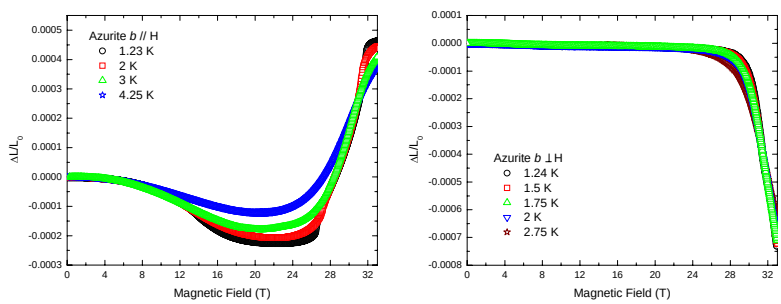

Figure 1 - Magnetostriction results measured parallel to the direction of the applied magnetic field for 2 crystalline orientations of azurite.

We can notice the effect of the 1/3 magnetic plateau for the *b* parallel to the field configuration for fields between 16 and 26 T (which agrees with [2]), giving us a constant magnetostriction. We also have observed that anisotropic magnetostriction occurs in azurite, giving us an indication of the magnetically induced structural distortions. We also found that for certain field ranges magnetostriction occurs along one crystalline axis and not the other, which is unusual to say the least.

Acknowledgements

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References

[1] Lang, M., *et al*, J. Phys.: Conf. Series **51**, 1, (2006).
[2] Kikuchi, H., *et al*. Physical Review Letters, **94**, 227201, (2005).