

Incommensurate Structure and Unconventional Spin-Peierls Behavior in TiOCl

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TiOCl is a quasi-one-dimensional spin $\frac{1}{2}$ quantum system, and a rare example of an inorganic compound which displays a spin-Peierls state, in which a dimerization of the crystal lattice leads to the formation of spin-singlet pairs at low temperatures, and a non-magnetic ground state. However, unlike conventional spin-Peierls systems, in TiOCl a first order spin-Peierls transition at $T_{c1} \sim 67\text{K}$ is preceded by a higher order phase transition at $T_{c2} \sim 92\text{K}$ [1]. We have performed x-ray scattering measurements on single crystal TiOCl using an 18kW rotating anode source. These measurements provide evidence of spin-Peierls dimerization below T_{c1} and show the development of an incommensurately modulated structure in the intermediate phase between T_{c1} and T_{c2} (as also reported in [2]). Furthermore, we present the first observations of commensurate fluctuations about the superlattice peak positions of the spin-Peierls state which persist above T_{c1} up to temperatures of approximately 130K.

[1] Shaz et al., Phys. Rev. B. 71, 100405(R) (2005).

[2] A. Krimmel et al., cond-mat/0601079 (2006).