Dielectric response of zig-zag spin chain β-TeVO4

14. Multifunctional magnetic materials: magnetic shape memory materials, multiferroics including artificial/composite multiferroics, and perovskites

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Materials in which magnetic orderings induce ferroelectricity are promising candidates for magnetoelectric effect (ME). On one hand, it provides an opportunity to explore fundamental interactions between charges, spin, orbital and lattice degrees of freedom. On the other hand, ME enables new directions for development of novel devices. Although bulk, non-composite magnetoelectric materials seem to be rare and elusive, one promising way to achieve the ME effect is through spiral magnetic orders which can allow the existence of electric dipoles by breaking the space inversion symmetry [1].

The quasi-one-dimensional quantum magnet β-$TeVO_4$ is a zig-zag spin chain system with anisotropic interactions between spins and a spiral ordered ground state [2,3]. Its phase diagram is complex: firstly, at T_{N1}=4.65 K the system paramagnetic phase gives way to an incommensurate spin-density wave in which spins are collinear. Then, below T_{N2}=3.28 K a spin stripe phase is observed [3,4]. This phase develops as a superposition of two spin density waves with a small difference in modulation and orthogonal direction of spin. Finally, at T_{N3}=2.28 K the difference between wave vectors disappears and the vector chiral ground state is established [5]. Most interestingly, at T_{N3} there are tantalizing indications of emergent electric dipoles, the nature and mechanism of which are still not resolved.

In this work we present the dielectric response of β-$TeVO_4$ single crystal samples in the static limit at low temperatures and in the presence of external magnetic field. The currently available magnetic phase diagram will be discussed in the context of dielectric properties, and of low-temperature magnetic ordering as a potentially multiferroic phase.

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