Coupling Of Charge Density Wave to A Spin Cycloid in Topological Semimetal $Ndsb_xte_{2-X-\Delta}$

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$LnSb_xTe_{2-x-\delta}$ (*Ln*= Lanthanide) is a family of square-net-derived magnetic topological semimetals that exhibits an evolving charge density wave (CDW) distortion, in which $\mathbf{q}_{CDW}$ is controllable by *x* and the distortion of the structure is localized within the square net[1]. Control of band filling by substitution allows for access to different topological states[2], making $LnSb_xTe_{2-x-\delta}$ an interesting system to study the interplay of crystal symmetry, band topology, magnetism, and electronic correlation. Previous studies on Gd[3] and Ce[4] members displaying CDW have shown complex magnetic phase diagrams which imply the interaction of the CDW with spins localized on Ln, but a dearth of magnetic structures have been solved within the CDW regime for this family of compounds. Herein, we report on the interaction of the CDW with magnetism in $NdSb_xTe_{2-x-\delta}$ via comparison of the undistorted square net member $NdSb_{0.94}Te_{0.92}$ with the CDW-distorted phase $NdSb_{0.48}Te_{1.37}$, using single-crystal x-ray diffraction, magnetometry, heat capacity, and neutron powder diffraction[5]. $NdSb_{0.94}Te_{0.92}$ is a collinear antiferromagnet with $T_N \sim 2.7$ K, where spins align parallel to the plane of the square net, but antiparallel to each other. $NdSb_{0.48}Te_{1.37}$ exhibits a CDW with a near-five-fold structural modulation ($\mathbf{q}_{CDW} = 0.18\mathbf{b}^*$), isostructural to previously studied $LnSb_xTe_{2-x-\delta}$ at similar *x*. The magnetic phase diagram of $NdSb_{0.48}Te_{1.37}$ is significantly more complex, with $T_N = 2.3$ K, additional metamagnetic transitions, and an elliptical cycloid magnetic structure ($\mathbf{q}_{mag} = -0.41\mathbf{b}^*$) determined by neutron diffraction. The magnitudes of $\mathbf{q}_{CDW}$ and $\mathbf{q}_{mag}$ fit to an integer relationship $1+2\mathbf{q}_{mag} = 2\,\mathbf{q}_{CDW}$, indicating a coupling relationship between the CDW and the spin cycloid. Finally, preliminary neutron diffraction on Ce analogue $CeSb_{0.57}Te_{1.4}$ indicates that the spin alignment of the undistorted parent may determine if the same coupling occurs in other *Ln*.

References

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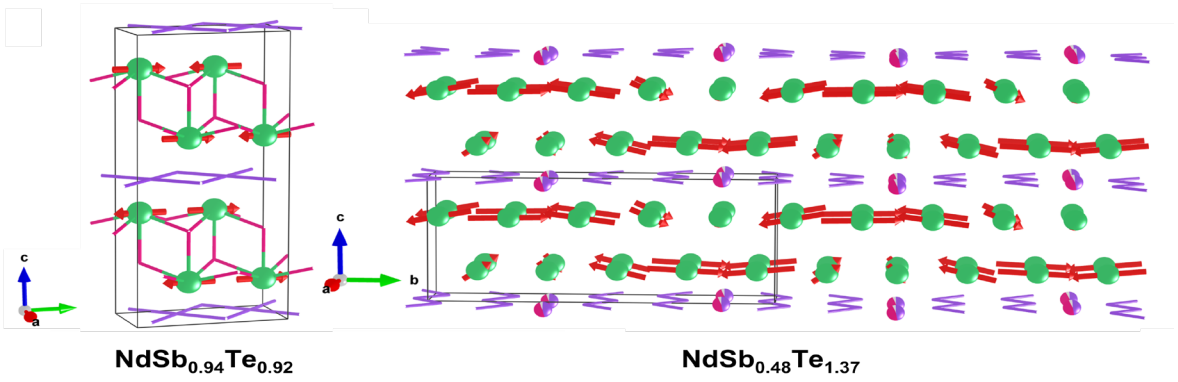

Figure 1