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Structure and Physical Properties of $SrNiRu_5O_{11}$ Single Crystals: A New Frustrated R-type Ferrite Based on Ordered Kagome Nets[1]

LANCE DE LONG, University of Kentucky, Department of Physics and Astronomy, LARYSA SHLYK, RAINER NIEWA, Universitt Stuttgart, Institut fr Anorganische Chemie — Single crystals of the R-type ferrite $SrNiRu_5O_{11}$ were grown from a chloride flux. The hexagonal crystal structure contains ruthenium located on Kagome nets, distorted due to formation of Ru–Ru dumbbells via metal-metal bonding. $SrNiRu_5O_{11}$ does not show long-range magnetic order down to 4.5 K. The low-temperature magnetic susceptibilities, $\chi_{\perp}$ and $\chi_{//}$ $\boldsymbol{c}$-axis, diverge as $T^{-0.3}$, and the electric resistivity varies as $T^{1.6}$ below 40 K, which is typical of non-Fermi liquid materials. This anomalous behavior might originate from the competition between residual magnetic interactions among Ni^{2+} ($S = 1$) spins and geometrical frustration on the two-dimensional Kagome lattice of Ru^{3+} ($S = 1/2$) spins. The transverse magnetoresistivity ρ_{xy}, of a $SrNiRu_5O_{11}$ single crystal at constant temperature $T = 5$ K for current-magnetic-field configurations, $\boldsymbol{J} \perp \boldsymbol{H} \,||\, \boldsymbol{c}$-axis and $\boldsymbol{J} \,||\, \boldsymbol{H} \perp \boldsymbol{c}$-axis, reveals no anomalous contribution, which is typical for non-magnetic materials. Fits of the heat capacity data below 10 K require a dominant, but unusual electronic term of the form $C_{el} = \gamma T^{1.2}$, which is expected for massless Dirac fermion states in topological insulators or spin liquid phases.

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Lance De Long
University of Kentucky, Department of Physics and Astronomy

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