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Anisotropy of magnetoresistivity in trilayered ruthenate Sr$_4$Ru$_3$O$_{10}$: Evidence for orbital dependent metamagnetism

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— Trilayered ruthenate Sr$_4$Ru$_3$O$_{10}$ is ferromagnetic with $T_c \approx 100$K and moderate in-plane magnetic field ($B_c \approx 2$T) induces an itinerant metamagnetic transition [1,2]. Such metamagnetism within a FM ground state cannot be understood with a single band model of a field-tuned Stoner transition. We have measured azimuthal angular dependence of in-plane and out-of-plane magnetoresistivity ($\rho_{ab}(\phi,B)$ and $\rho_c(\phi,B)$). We found that for $B<B_c$, at fixed field $\rho_{ab}(\phi)$ exhibits a two-fold anisotropy attributable to anisotropic behavior of an Ising ferromagnet, while $\rho_c(\phi)$ does not show such a behavior. For $B>B_c$, both $\rho_{ab}(\phi)$ and $\rho_c(\phi)$ exhibit a four-fold symmetry anisotropy, but the minimum value in $\rho_{ab}(\phi)$ and $\rho_c(\phi)$ occurs along different directions, i.e., [100] and [010] for $\rho_{ab}$, and [110] and [1T0] for $\rho_c$. Such a difference in anisotropic behavior between $\rho_{ab}(\phi)$ and $\rho_c(\phi)$ provides strong support that metamagnetism in Sr$_4$Ru$_3$O$_{10}$ is orbital dependent, i.e., ferromagnetic and metamagnetic bands coexist.


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