Antiferromagnetic Metallic State And Spin Valve Effect in Doped (Ca$_{1-x}$A$_x$)$_3$Ru$_2$O$_7$ (A = Sr, Ba) Single Crystals

S. CHIKARA, O.B. KORNETA, T.F. QI, S. PARKIN, G. CAO, Univ. of Kentucky, W.P. SONG, Inst. of Solid State Physics, Hefei 230031, P.R. China, W.P. CRUMMETT, Centre College, KY40422 — Bilayered Ca$_3$Ru$_2$O$_7$ is a highly anisotropic system [1] characterized by orbitally-driven colossal magnetoresistance$^2$ and an unusual antiferromagnetic metallic (AFM-M) state [2]. We report transport and thermodynamic properties of (Ca$_{1-x}$A$_x$)$_3$Ru$_2$O$_7$ (A = Sr, Ba) single crystals as a function of temperature and applied magnetic field. While Ba doping shows a far stronger impact, both Sr and Ba substitution for Ca induce a large array of interesting phenomena. Among them, a bulk spin-valve effect occurs in the AFM-M range, which is largely broadened due to the doping. This effect in bulk crystals is a novel phenomenon first observed in Ca$_3$(Ru$_{1-x}$Cr$_x$)$_2$O$_7$ single crystals [3]. The spin-valve effect in (Ca$_{1-x}$A$_x$)$_3$Ru$_2$O$_7$ single crystals opens new avenues to understand the underlying physics and realize the potential of spin valves in practical devices.


$^1$This work was supported by NSF through grant DMR-0552267.