Ground State Tuning by Spin-Orbit Coupling and Lattice Degrees of Freedom in Single-Crystal BaIr$_{1-x}$Ru$_x$O$_3$ ($0 \leq x \leq 1$)$^1$ K. BUTROUNA, S.J. YUAN, T.F. QI, J. TERZIC, S. ASWARTHAM, L.E. DELONG, G. CAO, Center for Advanced Materials, Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506, USA — BaIrO$_3$ is a magnetic insulator driven by spin-orbit coupling (SOC) whereas BaRuO$_3$ is a paramagnetic metal. The contrasting ground states provide a unique opportunity to study the role of the SOC and the lattice degrees freedom. Our investigation reveals that substitution of Ru$^{4+}$ ($4d^4$) ions for Ir$^{5+}$ ($5d^5$) ions in BaIrO$_3$ reduces the magnitude of the SOC and the structural distortion. There are two major effects of Ru additions: (1) Light Ru doping ($0 \leq x \leq 0.15$) prompts a simultaneous, precipitous drop in both the magnetic ordering temperature $T_C$ and the electrical resistivity, which exhibits a crossover behavior from a metallic to an insulating state near $T_C$. (2) Heavier Ru doping ($0.41 \leq x \leq 0.9$) induces a robust metallic state with a strong spin frustration.

$^1$This work was supported by the National Science Foundation (NSF) under Grants No. DMR-1265162; L.E.D. is supported by U.S. Department of Energy Grant No. DE-FG02-97ER45653.

S. J. Yuan
Center for Advanced Materials, Dept of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506, USA

Date submitted: 13 Nov 2014 

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