Synthesis of Sr$_2$Ir$_x$Ru$_{1-x}$O$_4$ via high-pressure floating zone technique

Zach Porter, Stephen D. Wilson  
Materials Department, University of California, Santa Barbara, 93106

In the past decade, researchers have uncovered a rich electronic phase diagram between the Mott insulating antiferromagnet Sr$_2$IrO$_4$ and the superconductor Sr$_2$RuO$_4$.

This phase diagram may host a quantum critical point between an insulating antiferromagnet and a paramagnetic metal, as seen for Cu and Fe-based superconductors. However, sample size has constrained available measurements, and sample quality may be obscuring quantum critical behavior and emergent magnetic phases. Here we describe the synthesis of single crystalline Sr$_2$Ir$_x$Ru$_{1-x}$O$_4$ (0<x<0.6) via a floating zone melting technique. We find that the use of a high-pressure gas environment (∼100 atm mixed O$_2$ and Ar) greatly decreases the evaporation of the IrO$_2$ reactant. The resultant gram-sized samples are more uniform in chemical composition and demonstrate unique magnetotransport properties compared to previous work on flux-grown samples. We will present preliminary characterization and thermodynamic results.

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