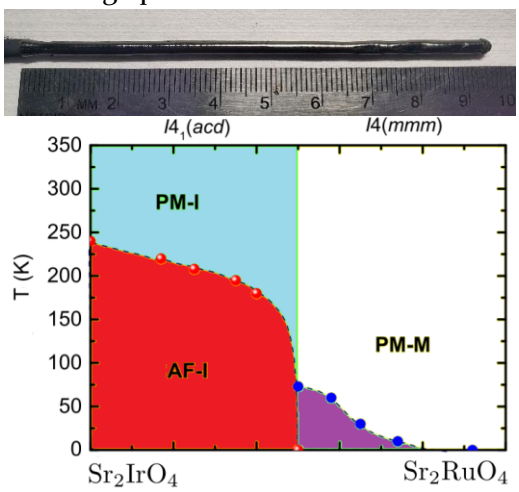
Synthesis of $Sr_2Ir_xRu_{1-x}O_4$ via high-pressure floating zone technique

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_2IrO_4 and the superconductor Sr_2RuO_4.[1] This phase diagram may host a quantum critical point between an insulating antiferromagnet and a paramagnetic metal,[2] as seen for Cu and Fe-based superconductors.[3] 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 $Sr_2Ir_xRu_{1-x}O_4$ ($0<x\leq0.6$) 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.



A floating zone sample of $Sr_2Ir_xRu_{1-x}O_4$ atop a tentative phase diagram, adapted from Reference 1. The purple phase is under investigation. Abbreviations: PM paramagnetic, AF antiferromagnetic, I insulator, M metal.

The research reported in this poster was supported by NSF Grant No. DMR-1905801. This research made use of the shared facilities of the NSF Materials Research Science and Engineering Center at UC Santa Barbara (DMR- 1720256). The UC Santa Barbara MRSEC is a member of the Materials Research Facilities Network. (www.mrfn.org).

References:

1. S.J. Yuan, S. Aswartham, J. Terzic, H. Zheng, H.D. Zhao, P. Schlottmann, and G. Cao. From J_{eff}= 1/2 insulator to p-wave superconductor in single-crystal $Sr_2Ir_{1-x}Ru_xO_4$ ($0\leq x\leq1$), *Phys. Rev. B* **92** (2015) 245103. DOI: 10.1103/PhysRevB.92.245103
2. S. Sachdev and B. Keimer. Quantum criticality, *Physics Today* **64** (2011) 29. DOI: 10.1063/1.3554314
3. S. Kasahara, T. Shibauchi, K. Hashimoto, K. Ikada, S. Tonegawa, R. Okazaki, H. Shishido, H. Ikeda, H. Takeya, K. Hirata, T. Terashima, and Y. Matsuda. Evolution from non-Fermi-to Fermi-liquid transport via isovalent doping in $BaFe_2(As_{1-x}P_x)_2$ superconductors, *Phys. Rev. B* **81** (2010) 184519. DOI: 10.1103/PhysRevB.81.184519