Searching for Superconductivity in Ruthenate Thin Films Grown by Molecular Beam Epitaxy

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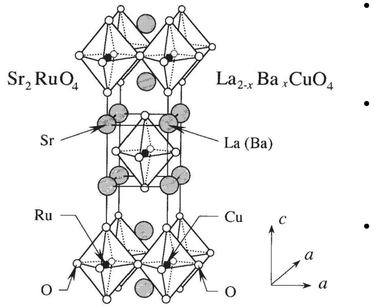
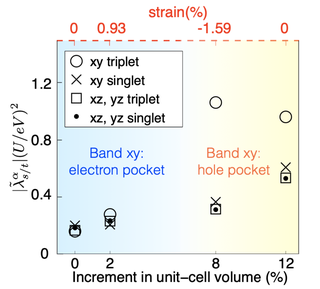
Introduction



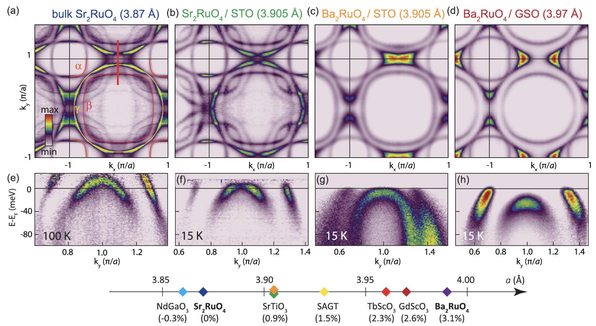
Maeno, Y., *et. al. Journal of the Physics Society of Japan* **81**, 011009 (2012)

- Sr_2RuO_4 first garnered interest due to its shared structure with high temperature superconductor $La_{2-x}Ba_xCuO_4$
- Although Sr_2RuO_4 did not display high temperature superconductivity, the possibility of it displaying spin-triplet, topological superconductivity is still debated
- Spin-triplet superconductors can be useful for quantum computing applications

- The use of epitaxial strain and chemical pressure through the replacement of strontium atoms with larger barium atoms increases the likelihood of spin-triplet pairing
- Angle-resolved photoemission spectroscopy (ARPES) shows the effect of strain and chemical pressure on the Fermi surface of Ba_2RuO_4, leading to the possibility of spin-triplet pairing

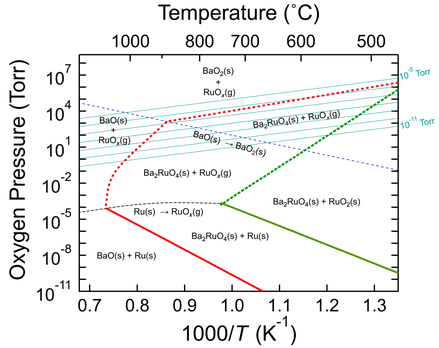


Hsu, Y.-T., *et. al. Physical Review B* **94**, 045118 (2016)



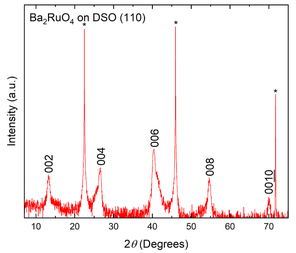
Burganov, B., *et. al. Physical Review Letters* **116**, 197003 (2016)

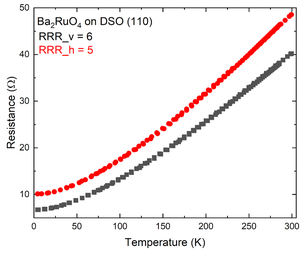
Experimental



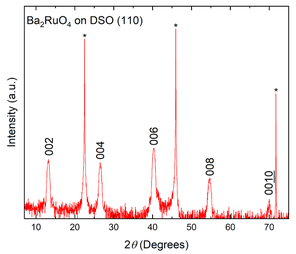
- Growth conditions were selected using the Ellingham diagram for Ba and Ru oxides
- We searched for the ideal growth conditions by attempting growth with various
  - Growth temperatures
  - Oxygen pressures
  - Ru/Ba flux ratios
- All growths were performed on $DyScO_3$ (DSO) substrates oriented in the (110) direction

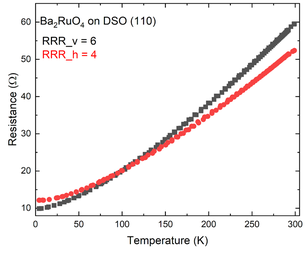
Results





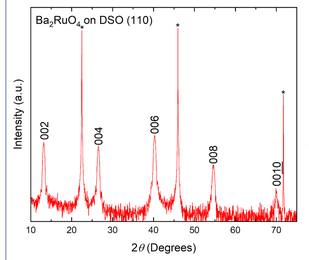
Growth Temperature: 845℃
Oxygen Pressure $5x10^{-7}$ torr
Ru/Ba Flux Ratio: 0.7

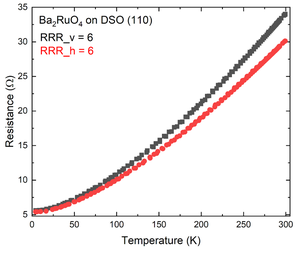




Growth Temperature: 850℃
Oxygen Pressure $5x10^{-7}$ torr
Ru/Ba Flux Ratio: 0.7

Results





Growth Temperature: 855℃
Oxygen Pressure $7x10^{-7}$ torr
Ru/Ba Flux Ratio: 0.8

Conclusions

- Single-phase Ba_2RuO_4 thin films isostructural to Sr_2RuO_4 can be successfully grown using molecular beam epitaxy
- Although the films can be grown, they do not display superconductivity. This is possibly due to impurities within the samples
  - Impurities greatly reduce the superconducting critical temperature for Ba_2RuO_4 and often suppress superconductivity completely in ruthenates

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References

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