High Pressure Oxygen Furnace

Neutron Scattering Group
Lab 1-12, Bldg. 555
Brookhaven National Lab

Manufacturer:
American Isostatic Presses (AIP)
Columbus, OH

Technical expert and operator:
Kim Mohanty

Hot Isostatic Press = HIP

Max pressure = 100 kpsi (6.9 kbar)
Max temperature = 1200°C
Gas = 20%O₂ + 80%Ar
(1.4 kbar O₂ partial pressure)
Sample volume = 1” diam, 6” high

Furnace insert; samples are loaded into Al₂O₃ before placing in furnace

Pressure vessel and yoke

gas manifold
Operation

History

Nov. 2011: Installation at BNL
Feb. 2012: Start of acceptance testing
Nov. 2012: Operational readiness evaluation
Apr. 2016: Final contract milestone/payment
Oct. 2016: HIP status Operational

Recent runs

Mar 29, 2016 (80 ksi, 1150C, 3 h)
Mar 28, 2016 (99 ksi, 1180C, 15 h)
Nov 3, 2015 (99 ksi, 500C, 5 days)
Oct 29, 2015 (99 ksi, 500C, 1.5 days)
Aug 5, 2015 (99 ksi, 600C, 7 h)

Some crystals tested
1200 C, 18 h

<table>
<thead>
<tr>
<th>Composition</th>
<th>% O change</th>
</tr>
</thead>
<tbody>
<tr>
<td>YNiO$_3$-$\delta$</td>
<td>0.2</td>
</tr>
<tr>
<td>YSrNiO$_4$-$\delta$</td>
<td>9.8</td>
</tr>
<tr>
<td>NdNiO$_3$-$\delta$</td>
<td>15.6</td>
</tr>
<tr>
<td>Y$_2$BaNiO$_5$+$\delta$</td>
<td>4.2</td>
</tr>
<tr>
<td>La$<em>{1.875}$Sr$</em>{0.25}$NiO$_4$+$\delta$</td>
<td>2.1</td>
</tr>
</tbody>
</table>

(by mass change)

Crystals of La$_2$CuO$_{4+\delta}$ after annealing

Ruidan Zhong and Genda Gu
La$_{1.9}$Ca$_{1.1}$Cu$_2$O$_{6+\delta}$

- Crystal grown by TSFZ
- 8 mm diam x 10 mm
- Annealed 1200°C for 10h
- As grown: non-superconducting
- After annealing: $T_c = 53.5$ K

The samples annealed for the longer treatment exhibited bulk superconducting transition near 55 K. The apparent reactivity of the samples was increased by longer annealing times, leading to increased oxygen doping. The apparent reactivity of the samples was increased by longer annealing times, leading to increased oxygen doping. The apparent reactivity of the samples was increased by longer annealing times, leading to increased oxygen doping. The apparent reactivity of the samples was increased by longer annealing times, leading to increased oxygen doping.

### Crystal grown by TSFZ
- Annealed in 20% O2
  - 1180 C/100 kpsi/10h
  - 1150 C/ 90 kpsi/ 5h
  - 1130 C/ 80 kpsi/16h
- $T_c = 45$ K

### Neutron scattering measurements
- at SEQUOIA/SNS

### Magnetic scattering

- John Scheeloch, Genda Gu, Guangyong Xu (unpublished)