EXPERIMENTAL STUDY OF NUCLEATION FOR Nb$_3$Sn DIFFUSION COATINGS ON NIOBIUM SRF CAVITIES

Uttar Pudasaini (College of William & Mary)
Grigory Eremeev, Charlie Reece (Jefferson Lab)
Michael Kelley (College of William & Mary and Jefferson Lab)
Introduction

- Nb$_3$Sn: 2 K -> 4.2 K $$$ !
- Application: only in coating form.
- Sn vapor diffusion: promising technique.
- Widely attempted since 1970s but ........
- Investigate Nucleation.

<table>
<thead>
<tr>
<th></th>
<th>Nb</th>
<th>Nb$_3$Sn</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_c$</td>
<td>9.2 K</td>
<td>18.3 K</td>
</tr>
<tr>
<td>$H_{sh}$</td>
<td>~200 mT</td>
<td>~400 mT</td>
</tr>
</tbody>
</table>

---

**Diagram:**
- Nucleation: 1 hr, 500°C
- Coating: 3 hrs, 1200°C
- Temperature vs. time, Pressure vs. Temperature

---

**Notes:**
- Nb Cavity
- Sn Vapor
- Insert
- Sn and SnCl$_2$, Pkgs.
- UHV Furnace
SEM/EDS Examination

Time Variation @ 500°C

- 5 min @ 500°C
- 1 hr @ 500°C
- 4 hr @ 500°C

Temperature Variation

- 1 hour @ 400°C
- 1 hour @ 450°C
- 1 hour @ 500°C

Nb Sn
SAM Examination of Different Nucleation Profiles

**CORNELL**

- With ~7µg/cm² SnCl₂
- 3 °C/min ramp to 5 hrs at 500 °C

**JLAB**

- With ~3 mg/cm² SnCl₂
- 6 °C/min ramp to 1 hrs at 500 °C

We acknowledge M. Liepe and D. Hall for Cornell Nucleation profile.