

EXPERIMENTAL STUDY OF NUCLEATION FOR Nb_3Sn DIFFUSION COATINGS ON NIOBIUM SRF CAVITIES

Uttar Pudasaini (College of William & Mary)

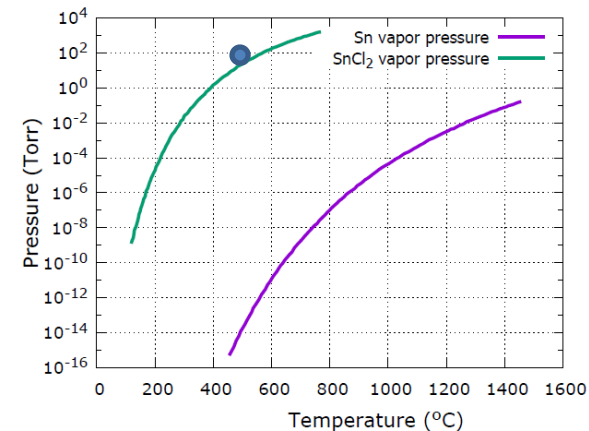
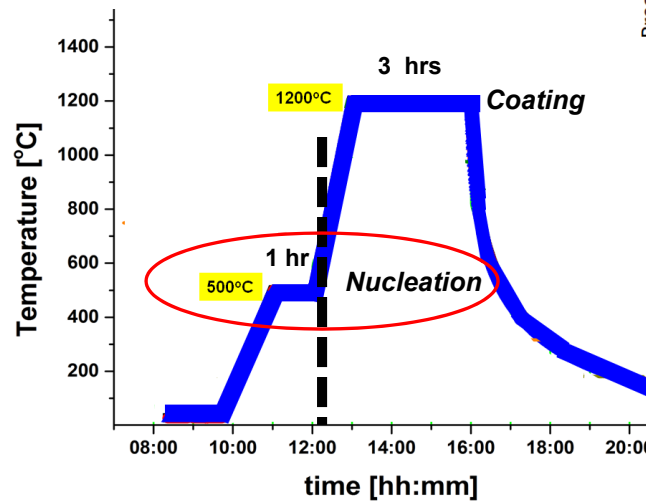
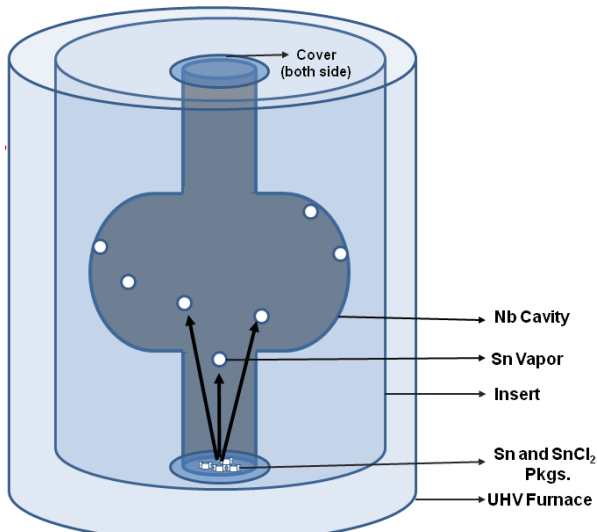
Grigory Ereemeev, Charlie Reece (Jefferson Lab)

Michael Kelley (College of William & Mary and Jefferson Lab)

Introduction

- Nb_3Sn : 2 K $\rightarrow$ 4.2 K \$\$\$\$\$!
- Application : only in coating form.
- Sn vapor diffusion : promising technique.
- Widely attempted since 1970s but
- Investigate Nucleation.

	Nb	Nb_3Sn
T_c	9.2 K	18.3 K
H_{sh}	~ 200 mT	~ 400 mT

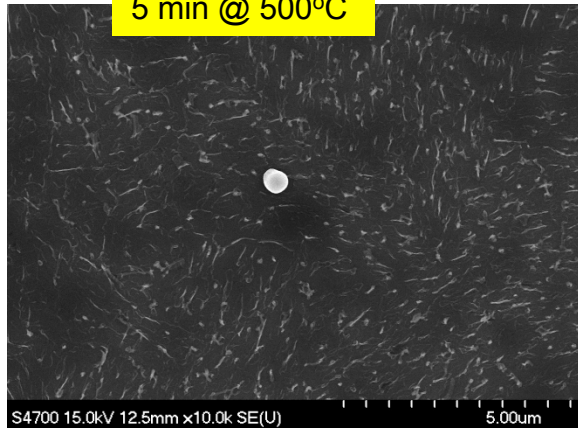


T ,
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Amount of SnCl_2

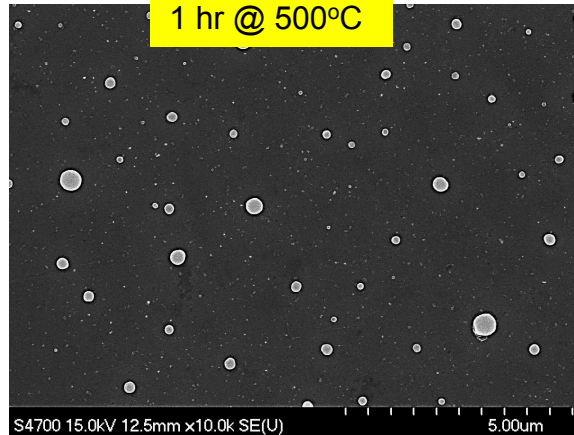
SEM/EDS Examination

Time Variation @ 500°C

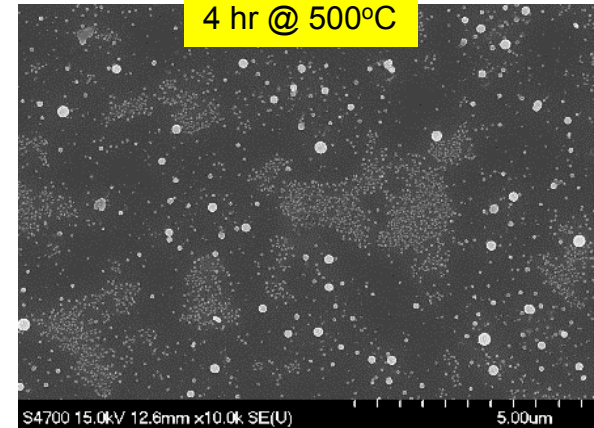
5 min @ 500°C



1 hr @ 500°C

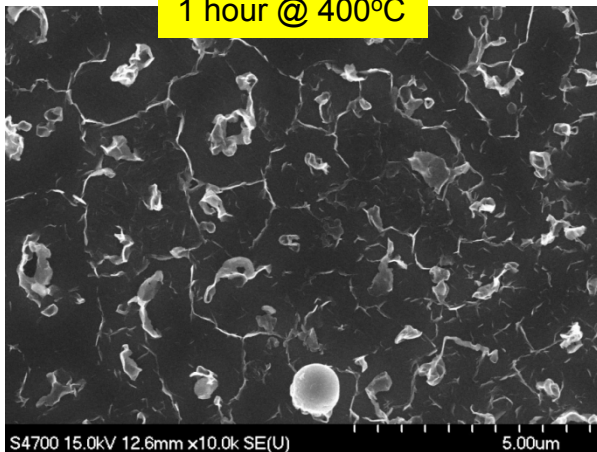


4 hr @ 500°C

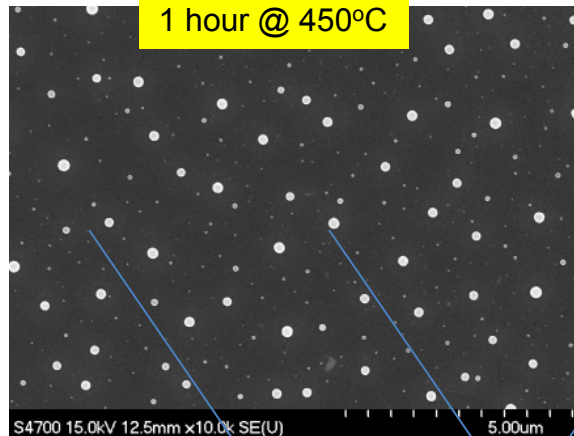


Temperature Variation

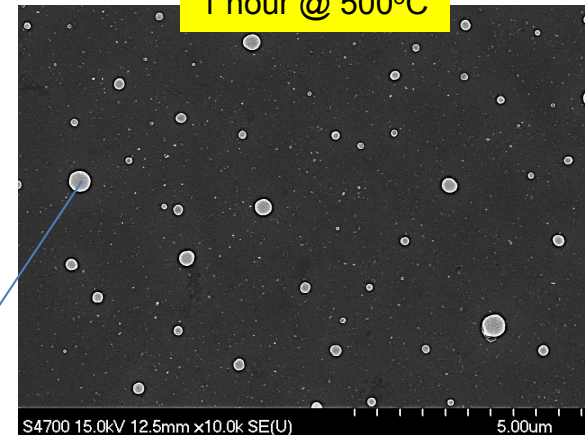
1 hour @ 400°C



1 hour @ 450°C



1 hour @ 500°C

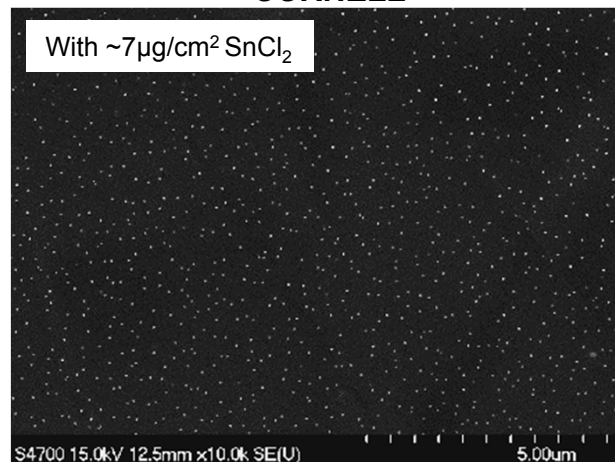


Nb

Sn

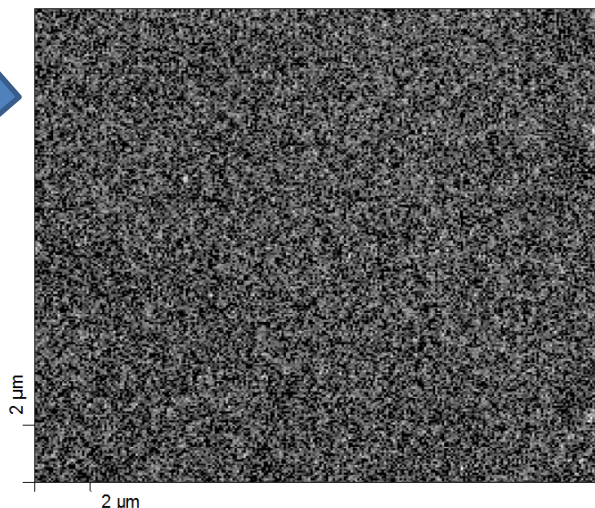
SAM Examination of Different Nucleation Profiles

CORNELL

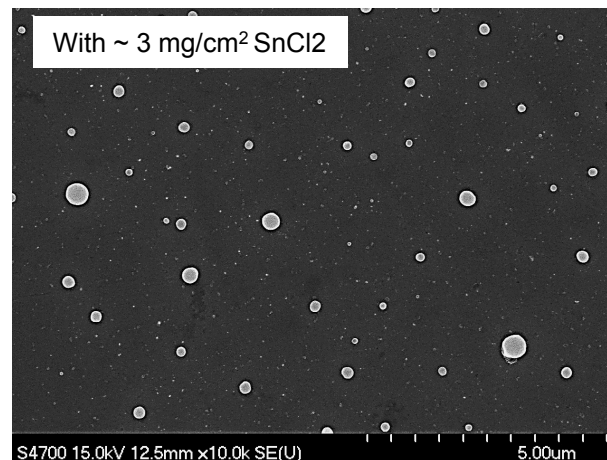


3 °C/min ramp to 5 hrs at 500 °C

Sn1

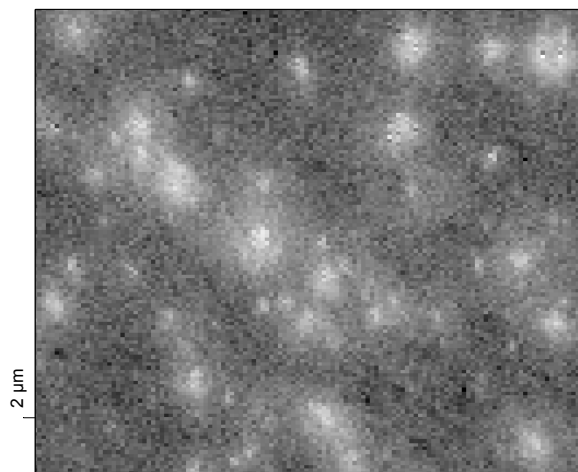


JLAB



6 °C/min ramp to 1 hrs at 500 °C

Sn1



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



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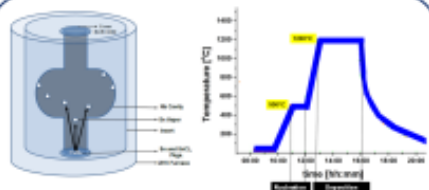


Introduction

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- Application : only coating form.
- Sn vapor diffusion : promising technique.
- Widely attempted but
- Investigate Nucleation.

	Nb	Nb ₃ Sn
Critical Temperature	9.2 K	18.2 K
Superconducting field	>200 mT	>400 mT

Nb₃Sn Coating Process

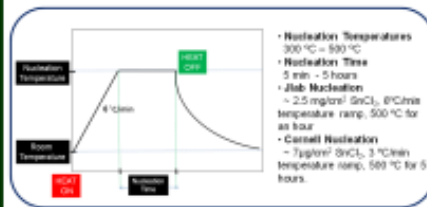


Nucleation

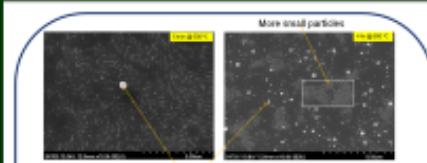
- $SnCl_2$ - Produce tin sites early.
- Evaporated tin join later to form Nb_3Sn phase.
- Effect on uniformity and coverage.
- Impact on final coating?



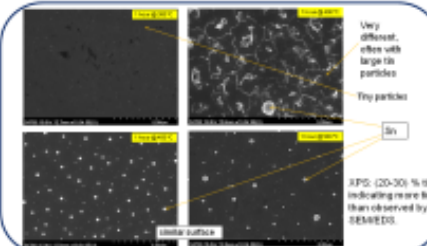
Experiments



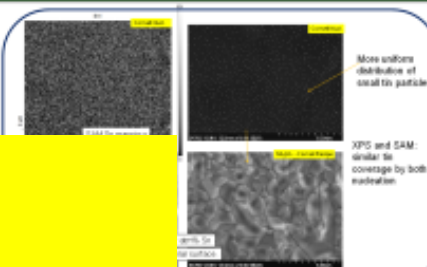
Nucleation Time Variation at 500 °C



Variation of Nucleation Temperature



Jefferson Lab and Cornell Nucleation Profile



Conclusion

- $SnCl_2$ deposits tin particles and tin film on niobium surface.
- No Chlorine.
- Amount of $SnCl_2$ is not crucial for tin coverage, but larger amount of $SnCl_2$ produces bigger tin particles.
- Very small amount of tin with 300 °C nucleation, 400 °C nucleation results in different surfaces than 450 or 500 °C nucleation.

Acknowledgment

- Co-authored by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-00OR21477.
- We are grateful for support from the Office of High Energy Physics, U.S. Department of Energy under grant DE-SC-0014479 to the College of William and Mary.
- We would like to thank Matthias Lepe and Daniel Hall for providing information on Cornell Nb_3Sn coating recipe, and coated sample.



THPRC002
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