A15 Superconductors
by
Thermal Diffusion in 6 GHz Cavities

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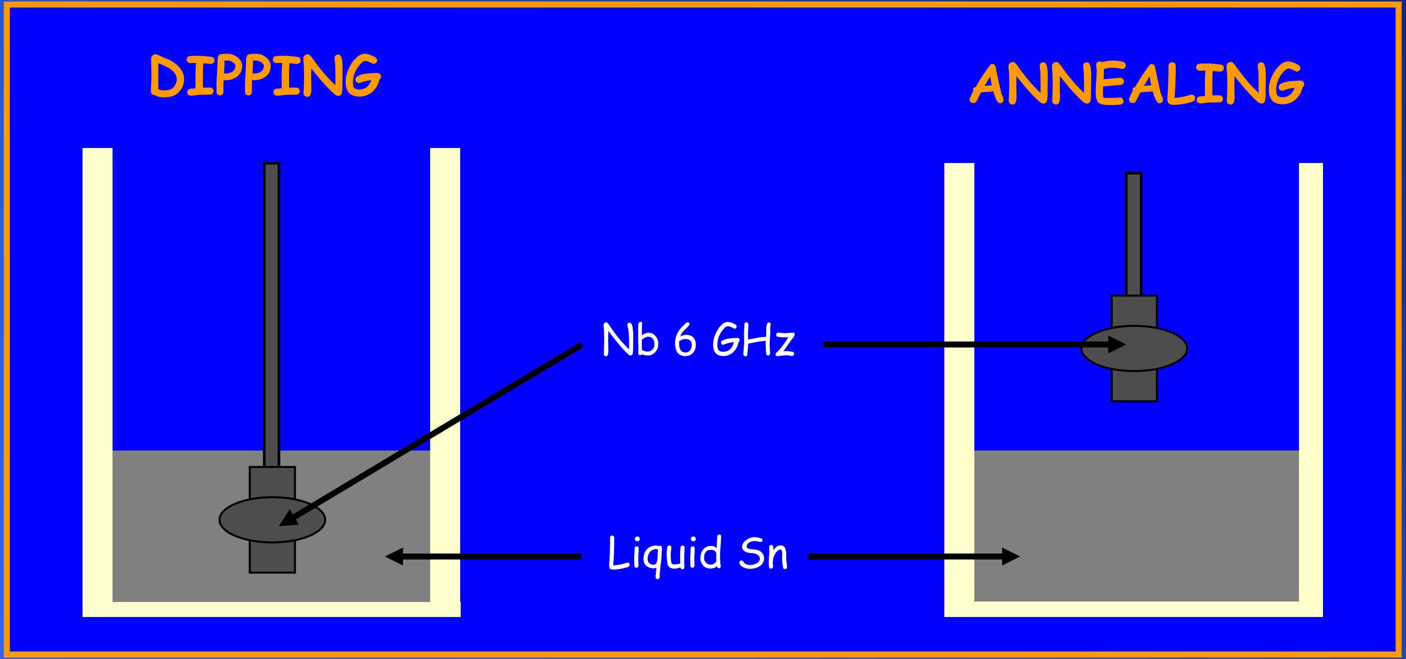
TECHNIQUE

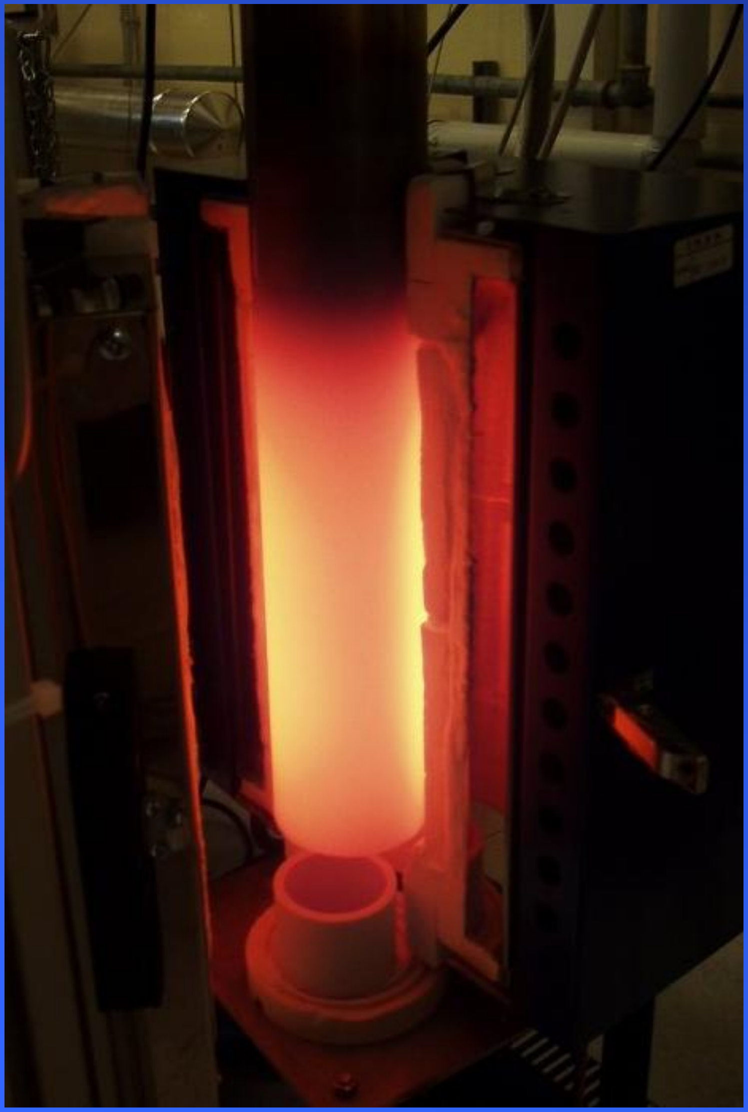
Nb_3Sn is obtained through

THE LIQUID Sn DIFFUSION TECHNIQUE



- No nucleation sites on Nb are required
- Fast growth of Nb_3Sn layer

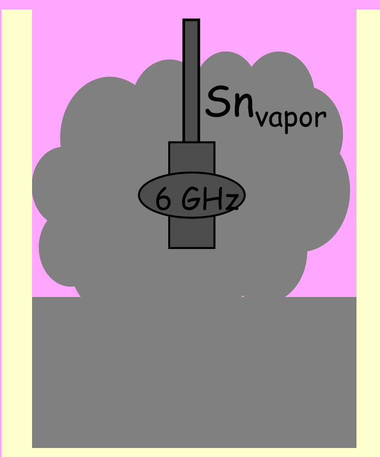
EXPERIMENTAL APPARATUS



THREE PROCEDURES

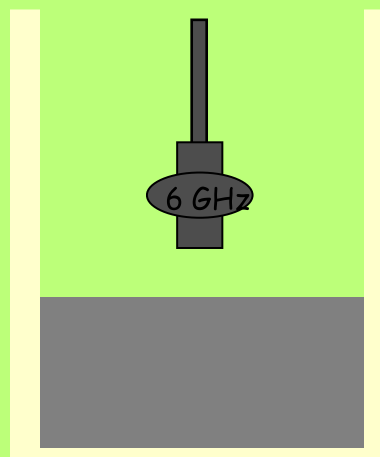
1

Sn vapor Annealing



2

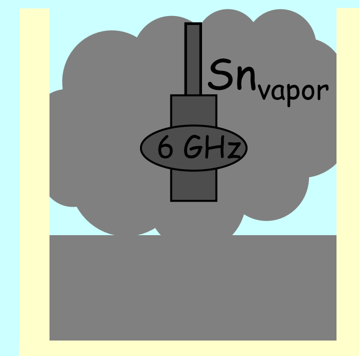
Vacuum Annealing



3

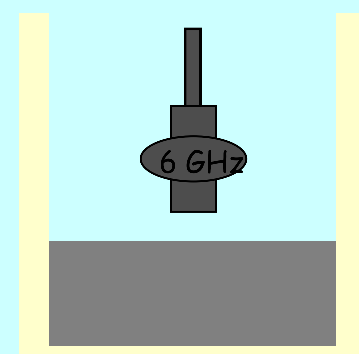
Double Process

Sn vapor Annealing



+

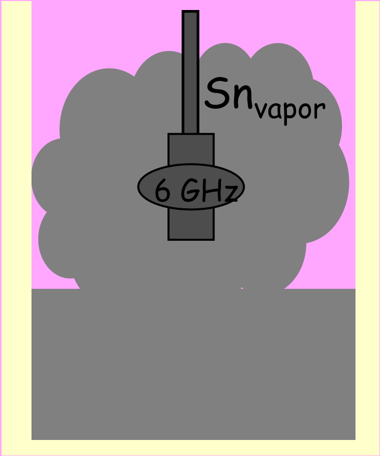
Vacuum Annealing

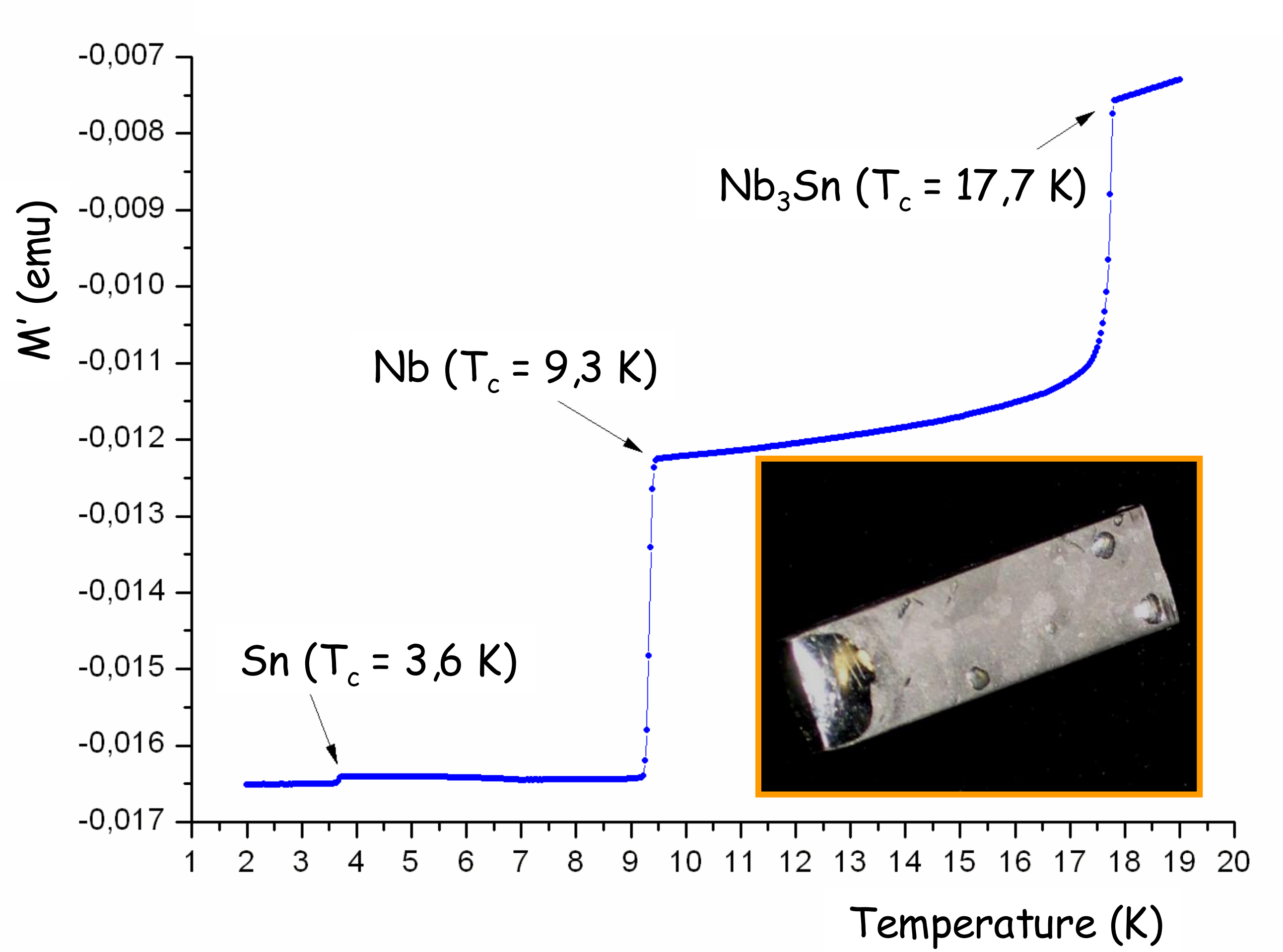


Sn VAPOR ANNEALING

1

Sn vapor Annealing



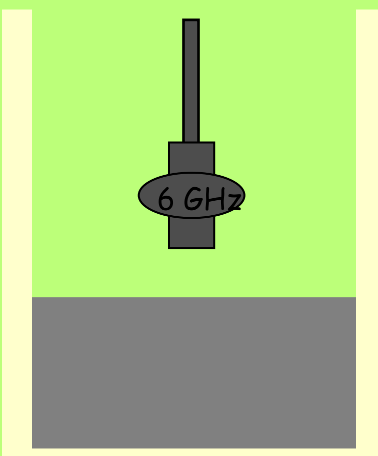


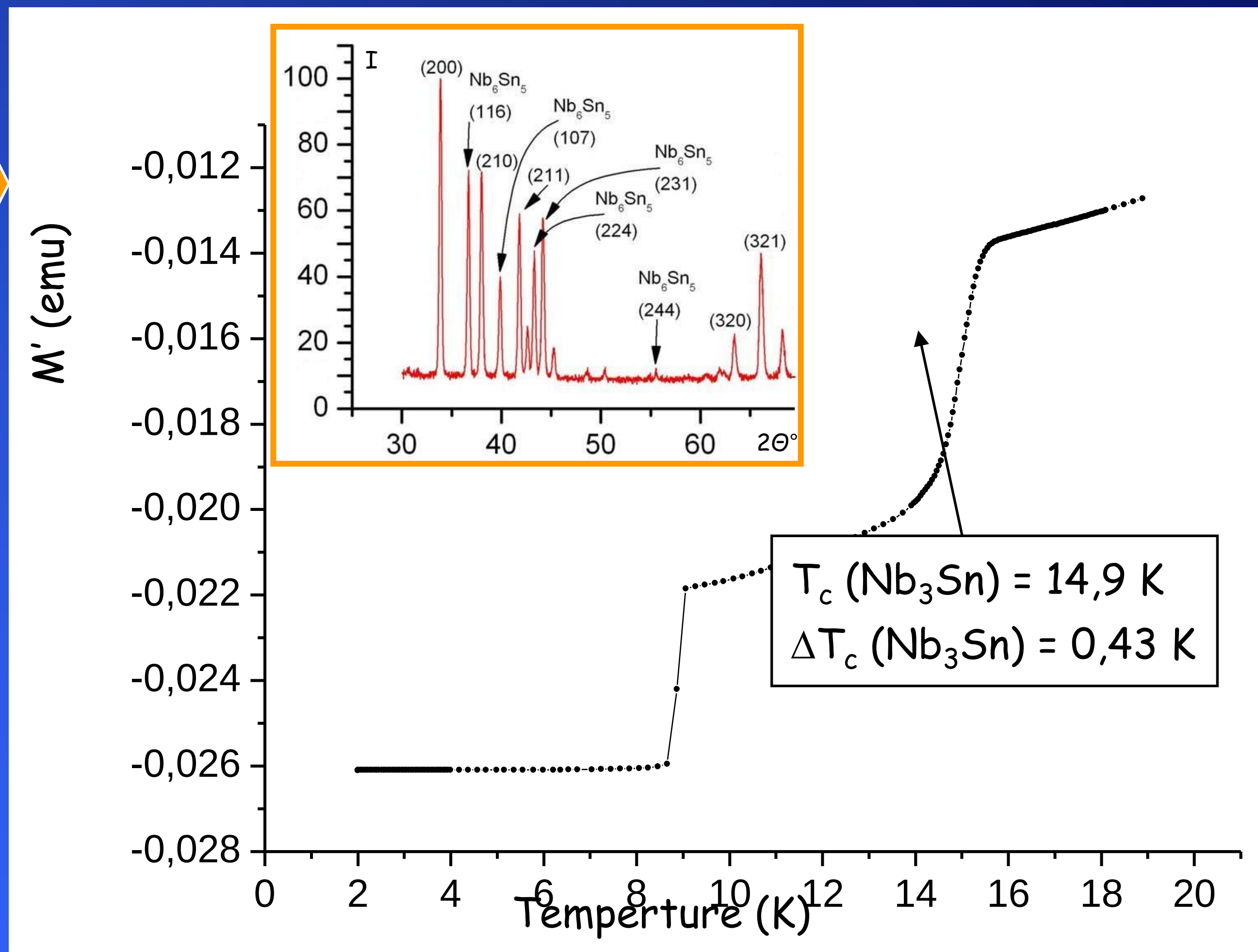
- residual Sn
- spurious phases

VACUUM ANNEALING

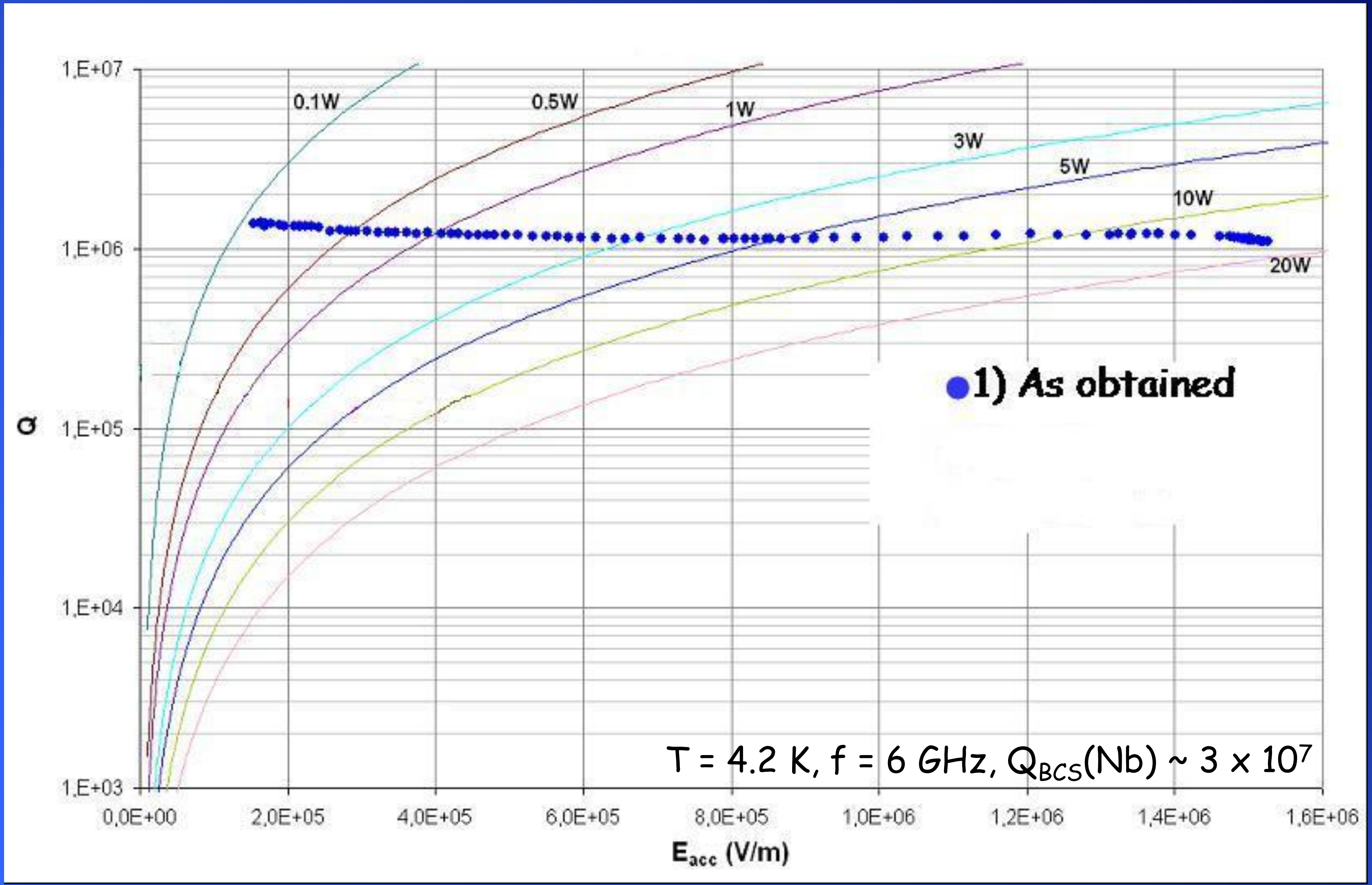
2

Vacuum Annealing





- low T_cs
- spurious phases

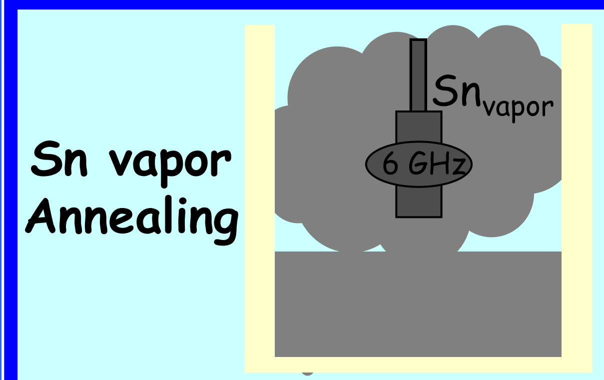


1,E+07
1,E+06
1,E+05
1,E+04
1,E+03
Q
0,0E+00
2,0E+05
4,0E+05
6,0E+05
8,0E+05
1,0E+06
1,2E+06
1,4E+06
1,6E+06
E_acc (V/m)
0.1W
0.5W
1W
3W
5W
10W
20W
1) As obtained
T = 4.2 K, f = 6 GHz, Q_BCS(Nb) ~ 3 x 10^7

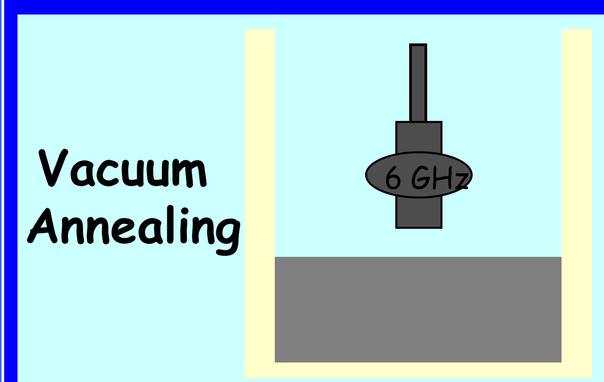
DOUBLE PROCESS

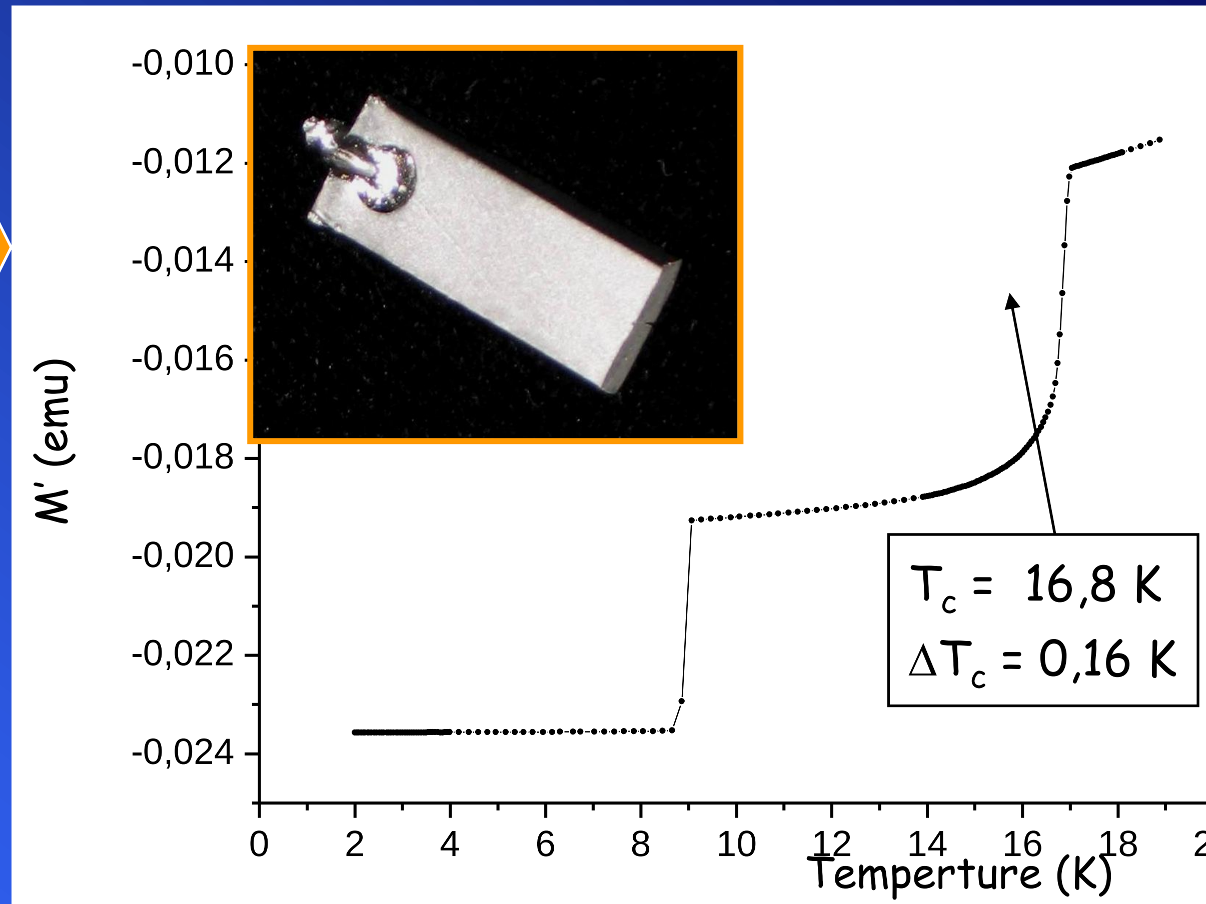
3

Double Process



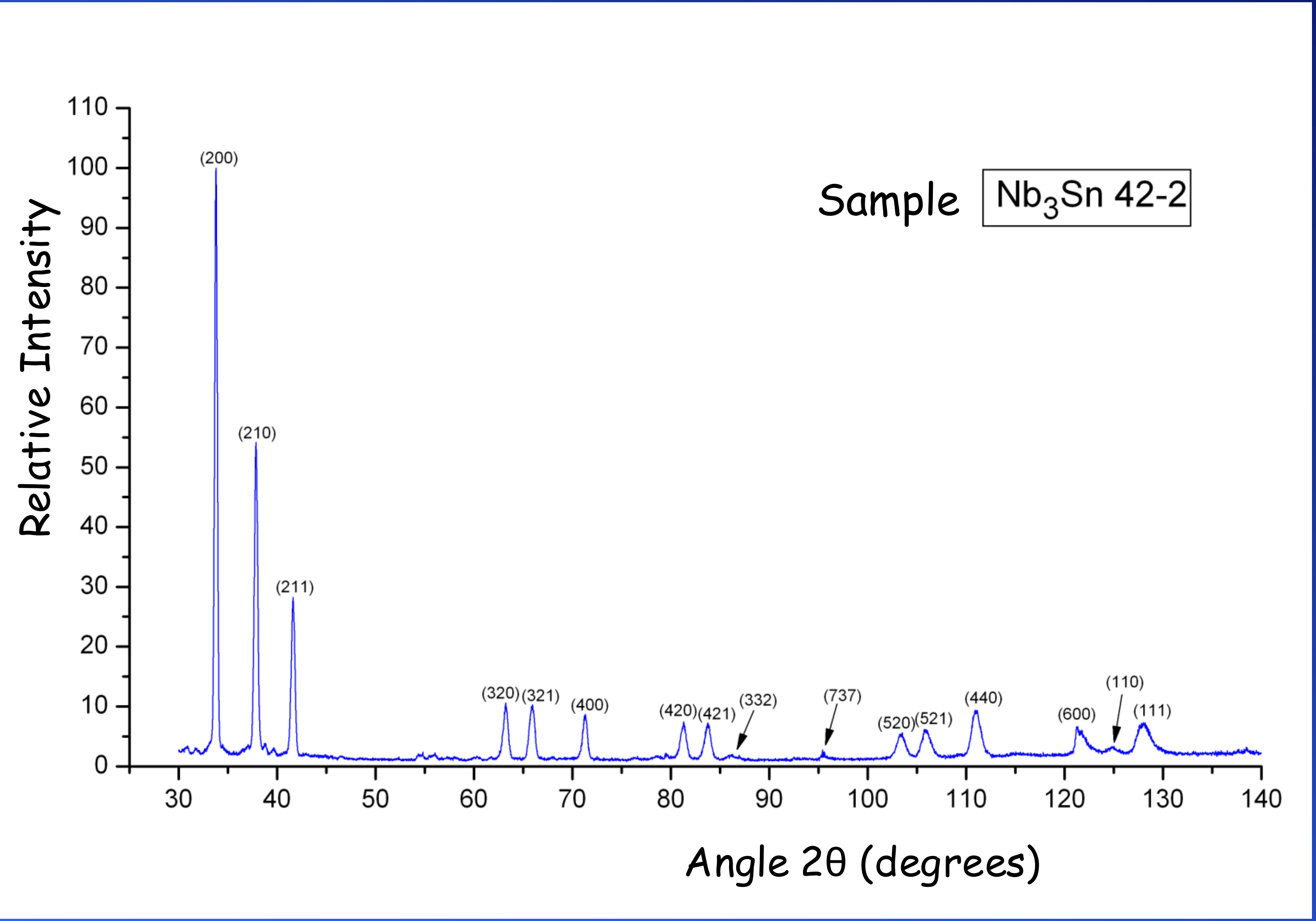
+





- good T_cs,
- no residual Sn,
- no spurious phases

XRD

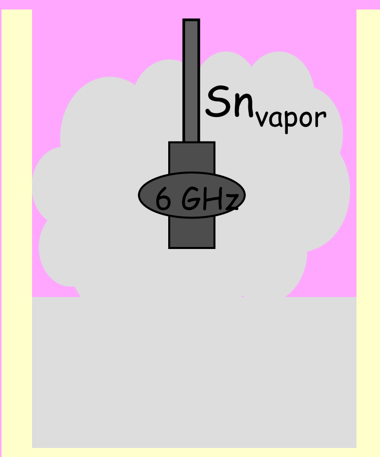


Sample
Nb3Sn 42-2
Relative Intensity
Angle 2θ (degrees)
(200)
(210)
(211)
(320)
(321)
(400)
(420)
(421)
(332)
(737)
(520)
(521)
(440)
(600)
(110)
(111)
0
10
20
30
40
50
60
70
80
90
100
110
30
40
50
60
70
80
90
100
110
120
130
140

THE CHOSEN PROCEDURE

1

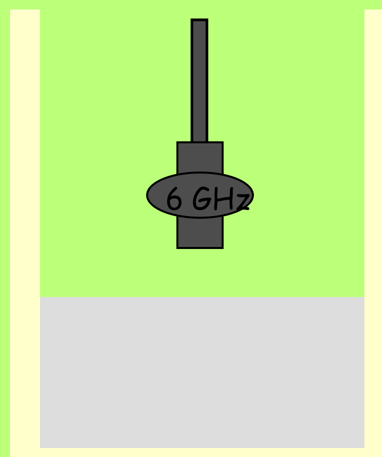
Sn vapor Annealing



- residual Sn
- spurious phases

2

Vacuum Annealing

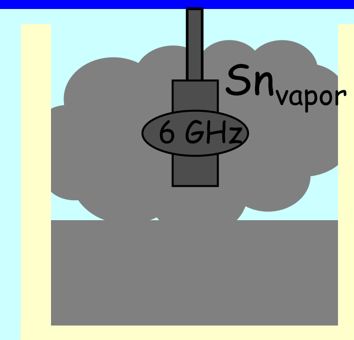


- low T_cs
- spurious phases

3

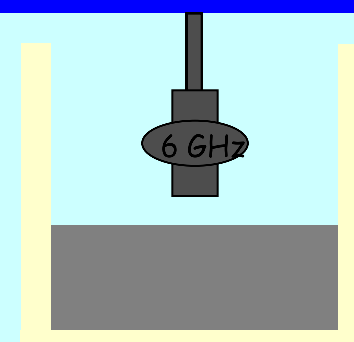
Double Process

Sn vapor Annealing



+

Vacuum Annealing



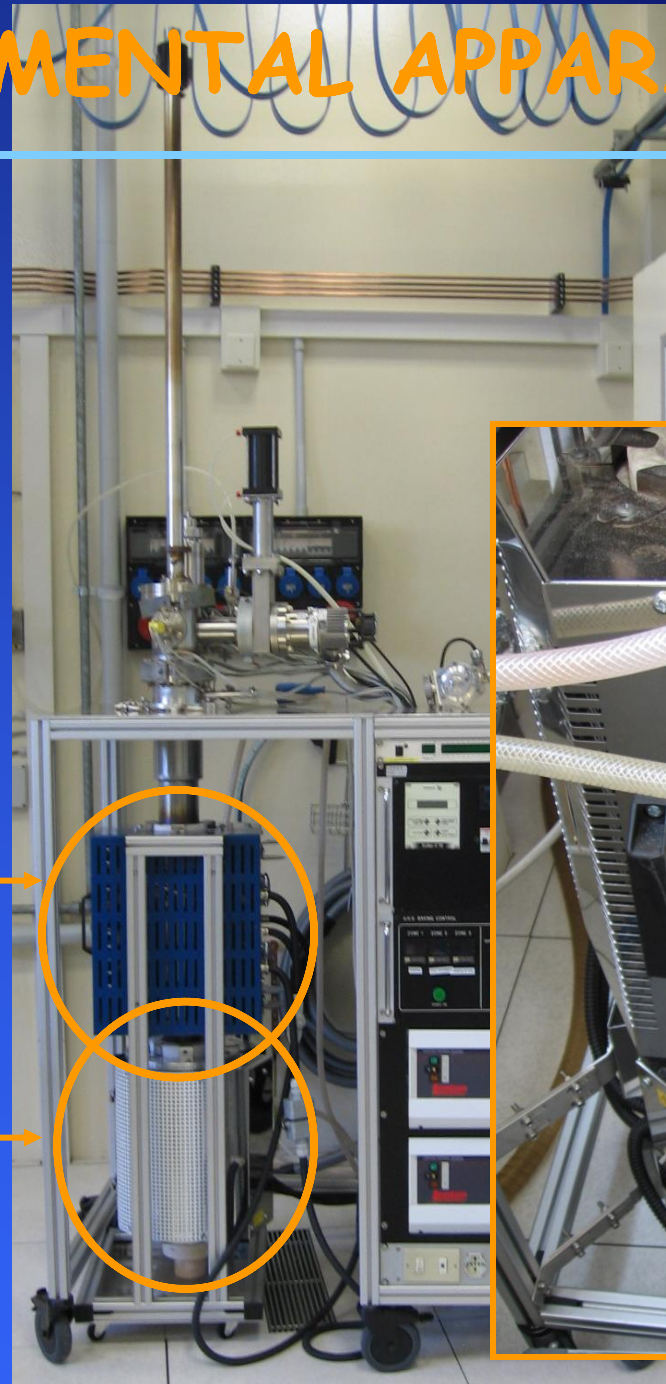
- good T_cs,
- no residual Sn,
- no spurious phases

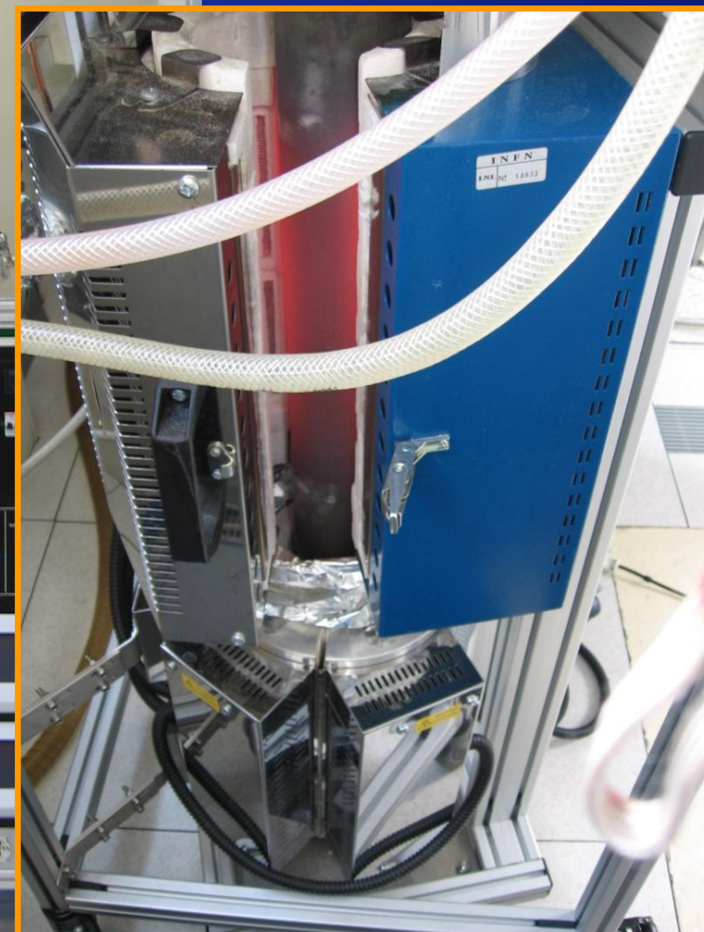
NEW EXPERIMENTAL APPARATUS

No air contamination while opening the vacuum system

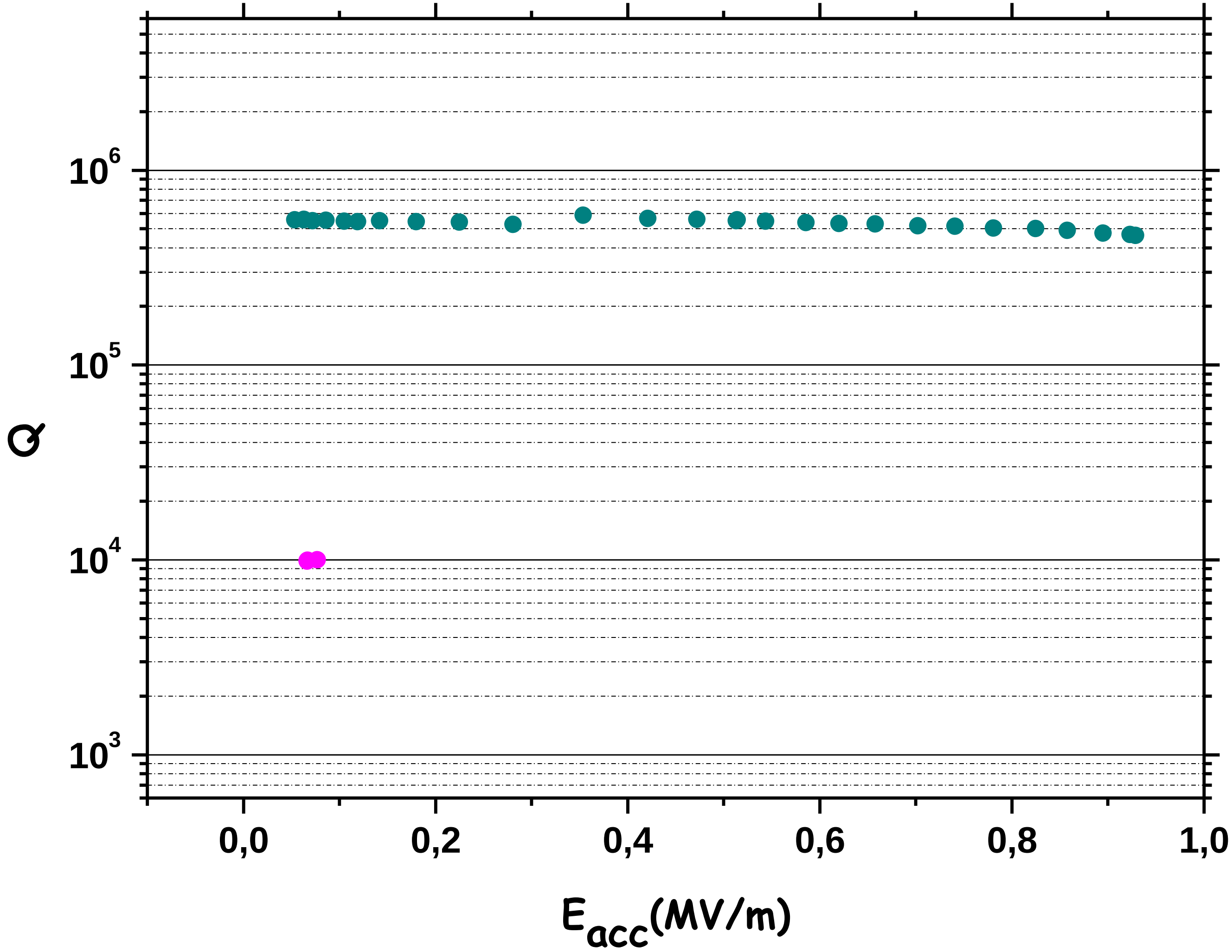
Annealing Furnace

Dipping Furnace



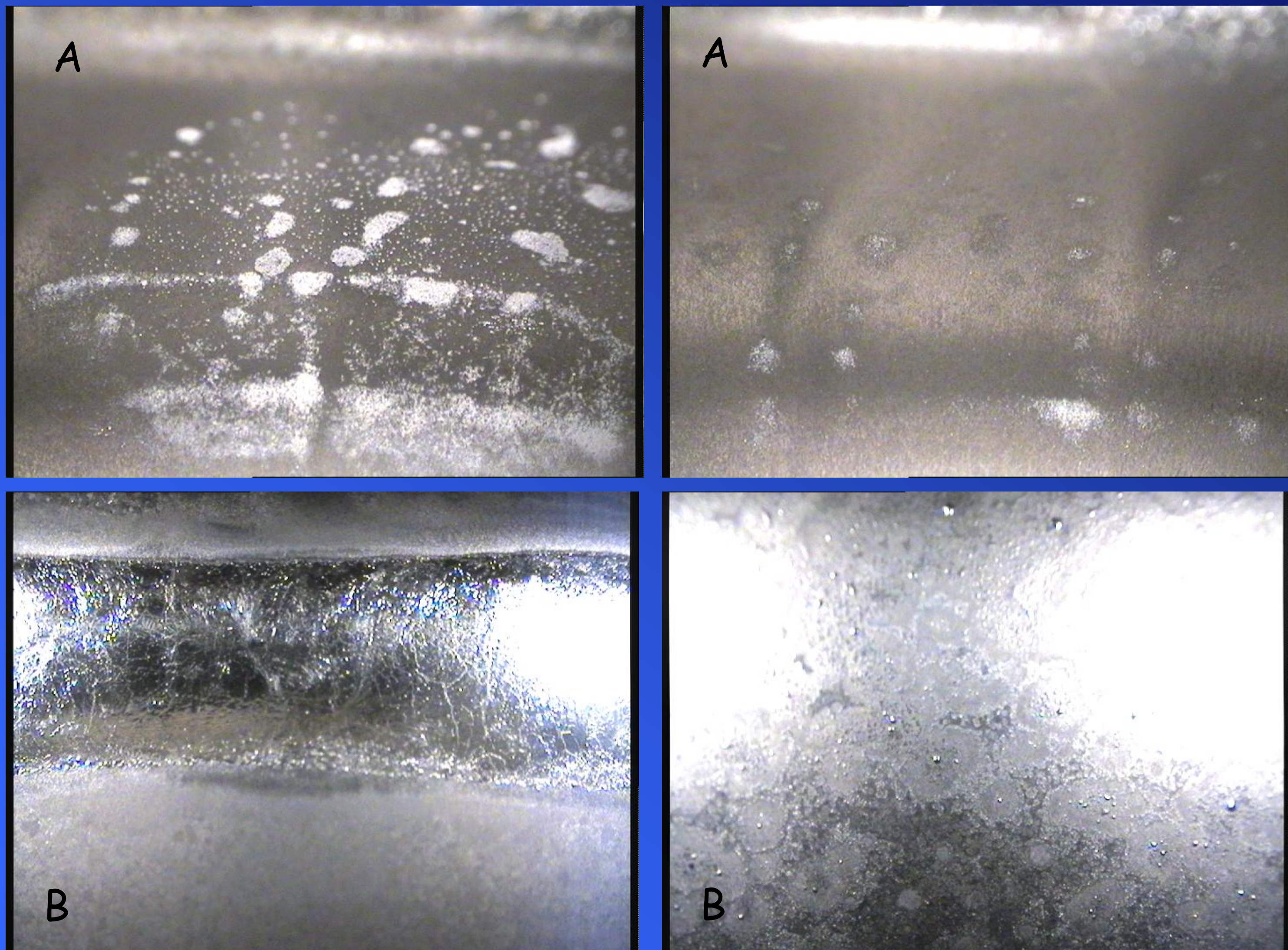


Q vs E_{acc}



T = 4.2 K, f = 6 GHz, Q_{BCS}(Nb) ~ 3 x 10^7

OPTICAL DIAGNOSTIC

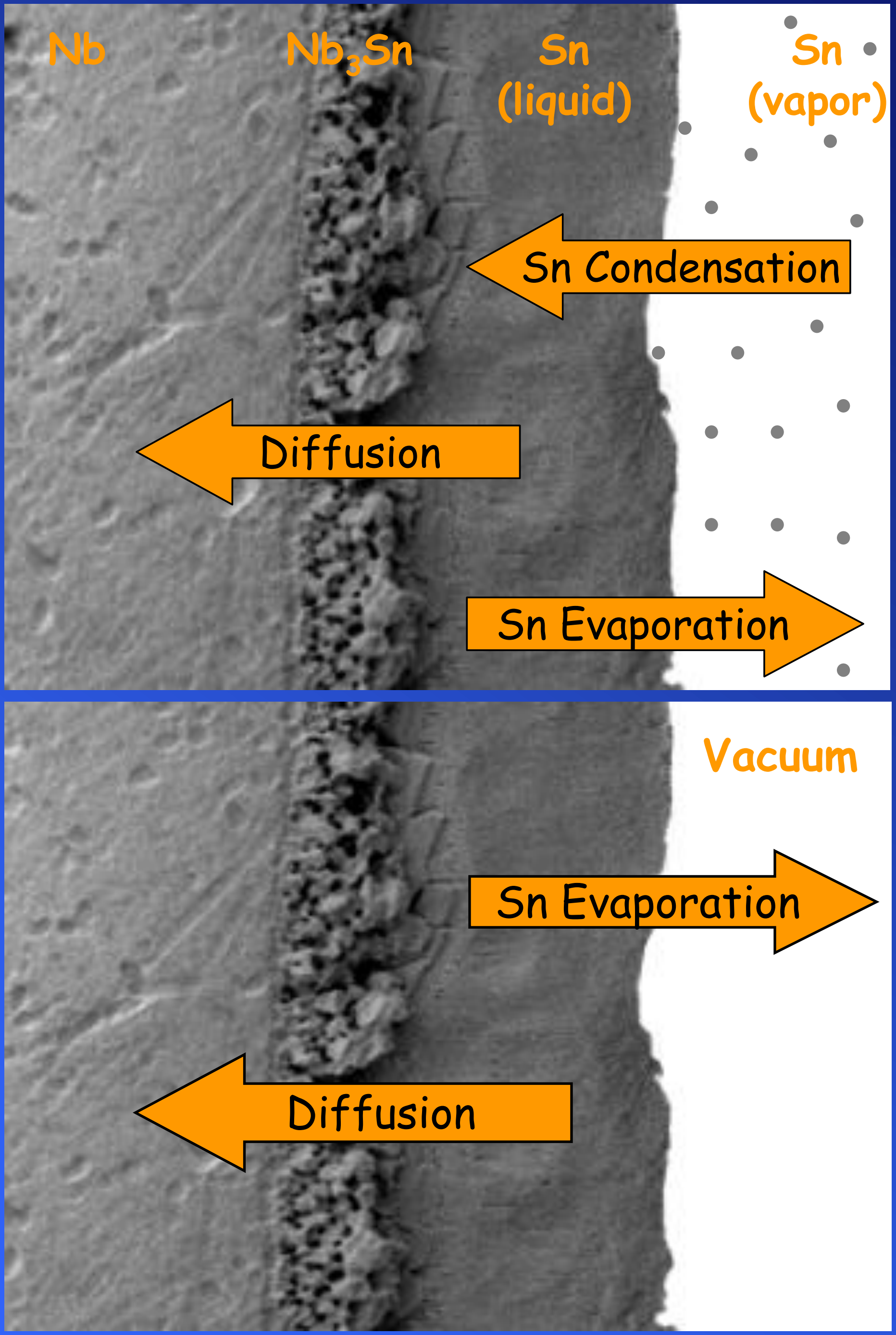


PRESENT WORK

1) **Droplets elimination changing the process T and t**

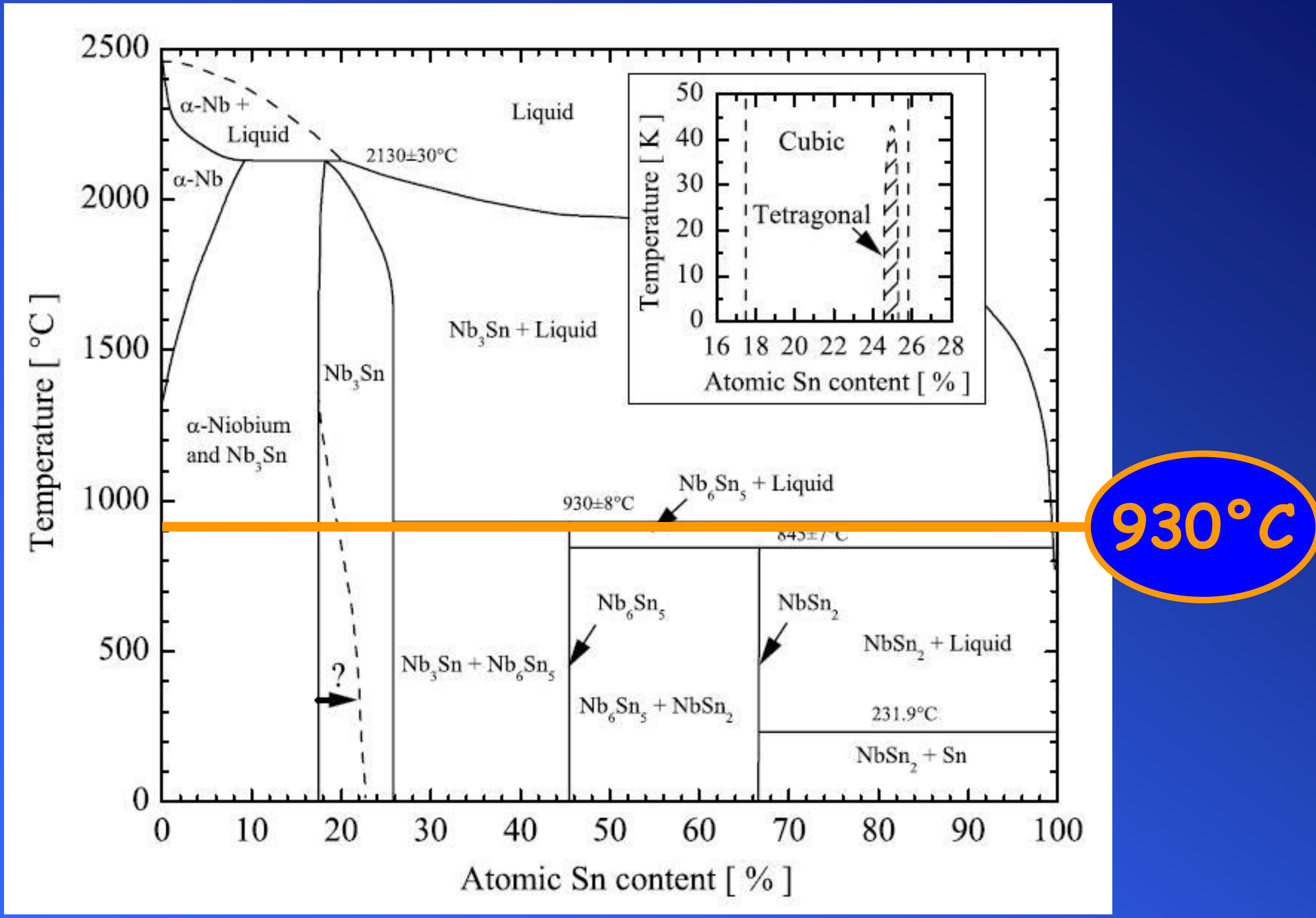
2) Chemical polishing

3) Prevent Sn droplets through the cavity vibration



Nb
Nb_3Sn
Sn (liquid)
Sn (vapor)
Sn Condensation
Diffusion
Sn Evaporation
Vacuum
Sn Evaporation
Diffusion

WORKING TEMPERATURE



PRESENT WORK

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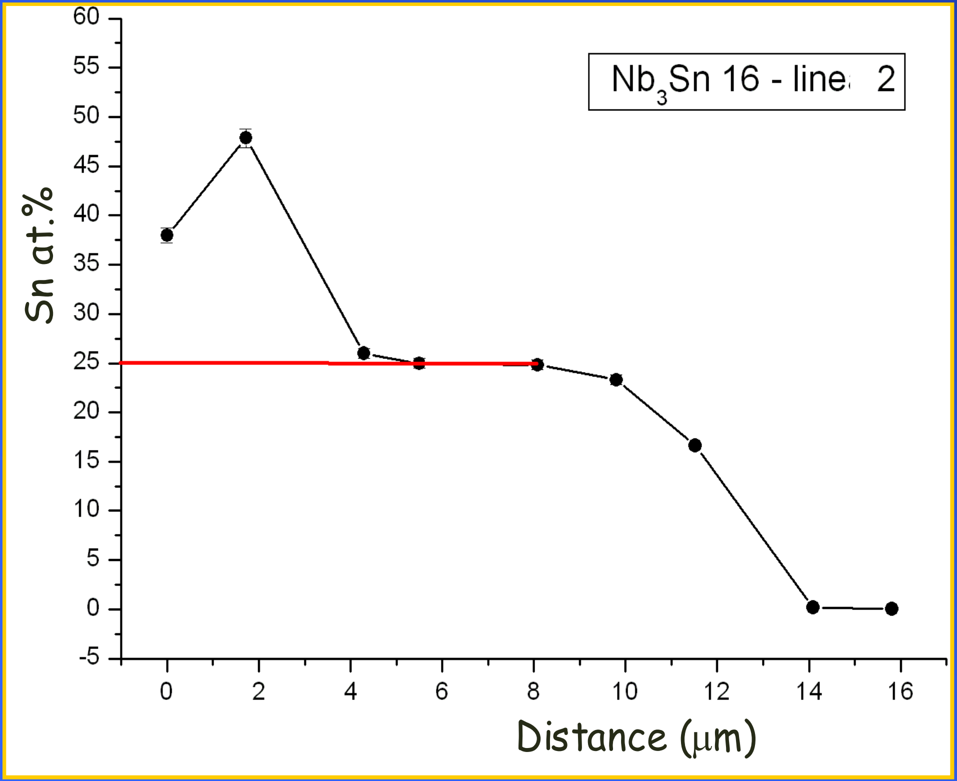
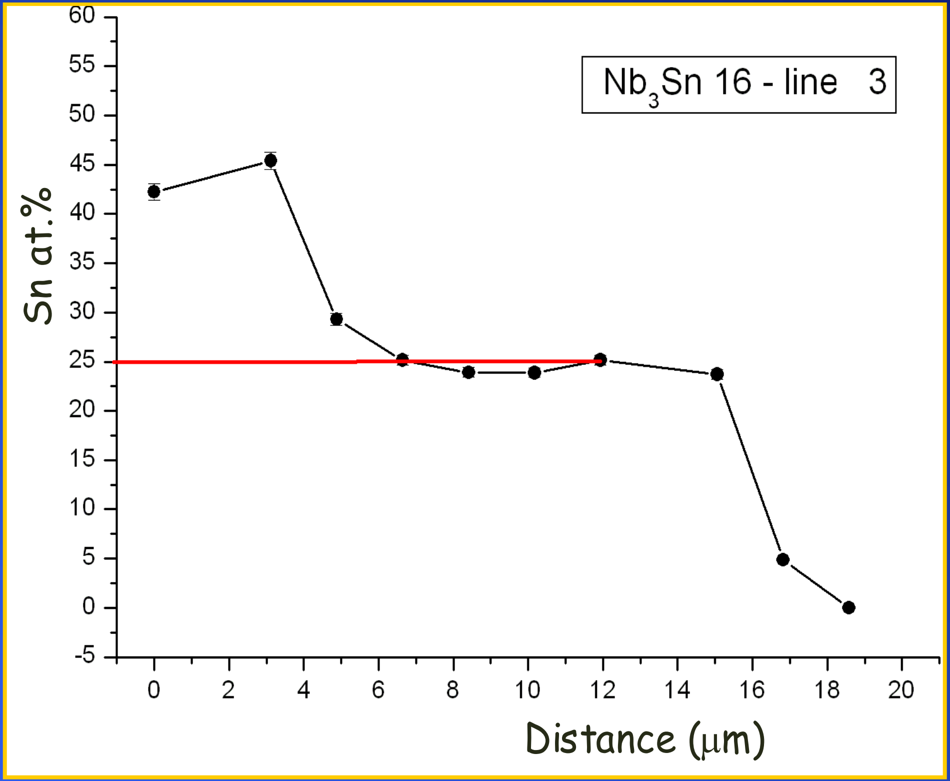
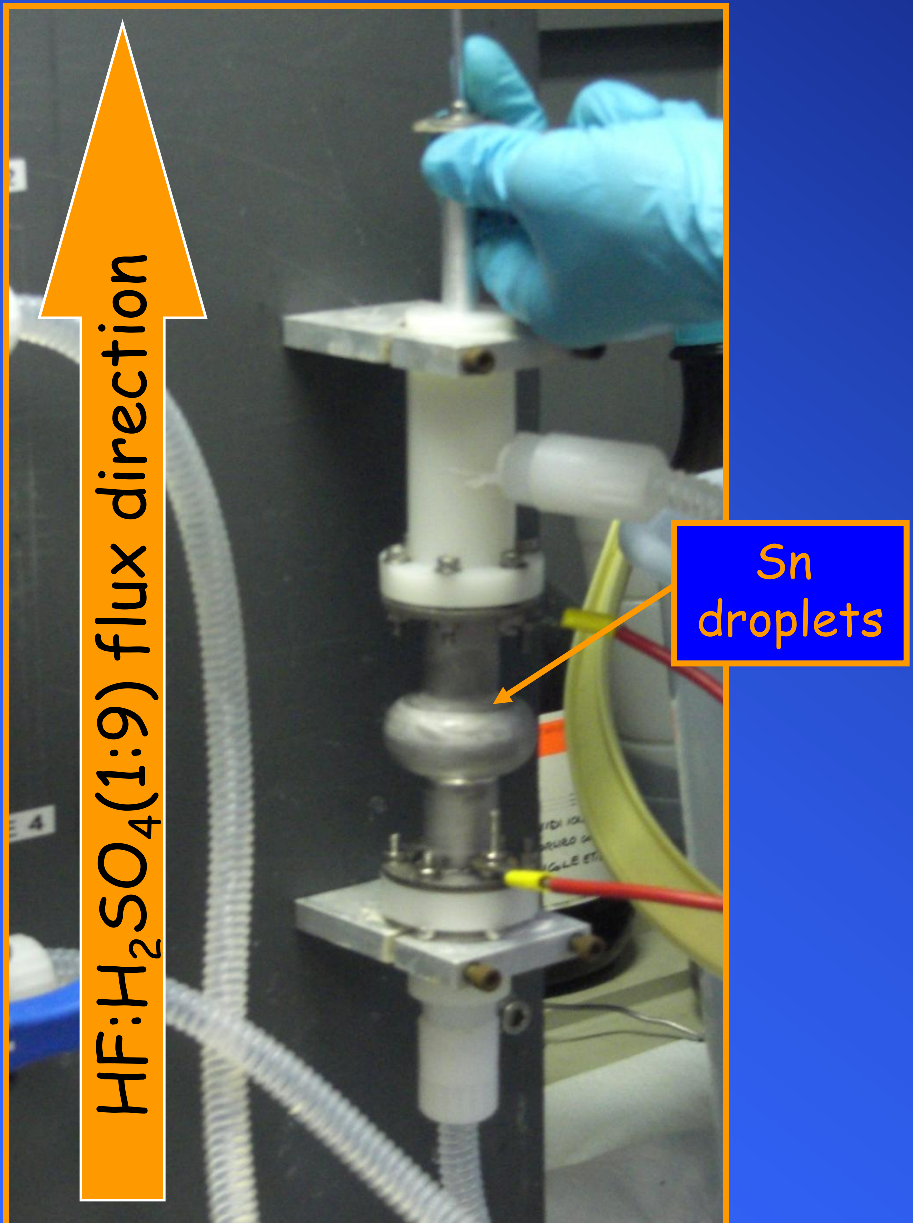
ELECTRON MICROPROBE ANALYSIS





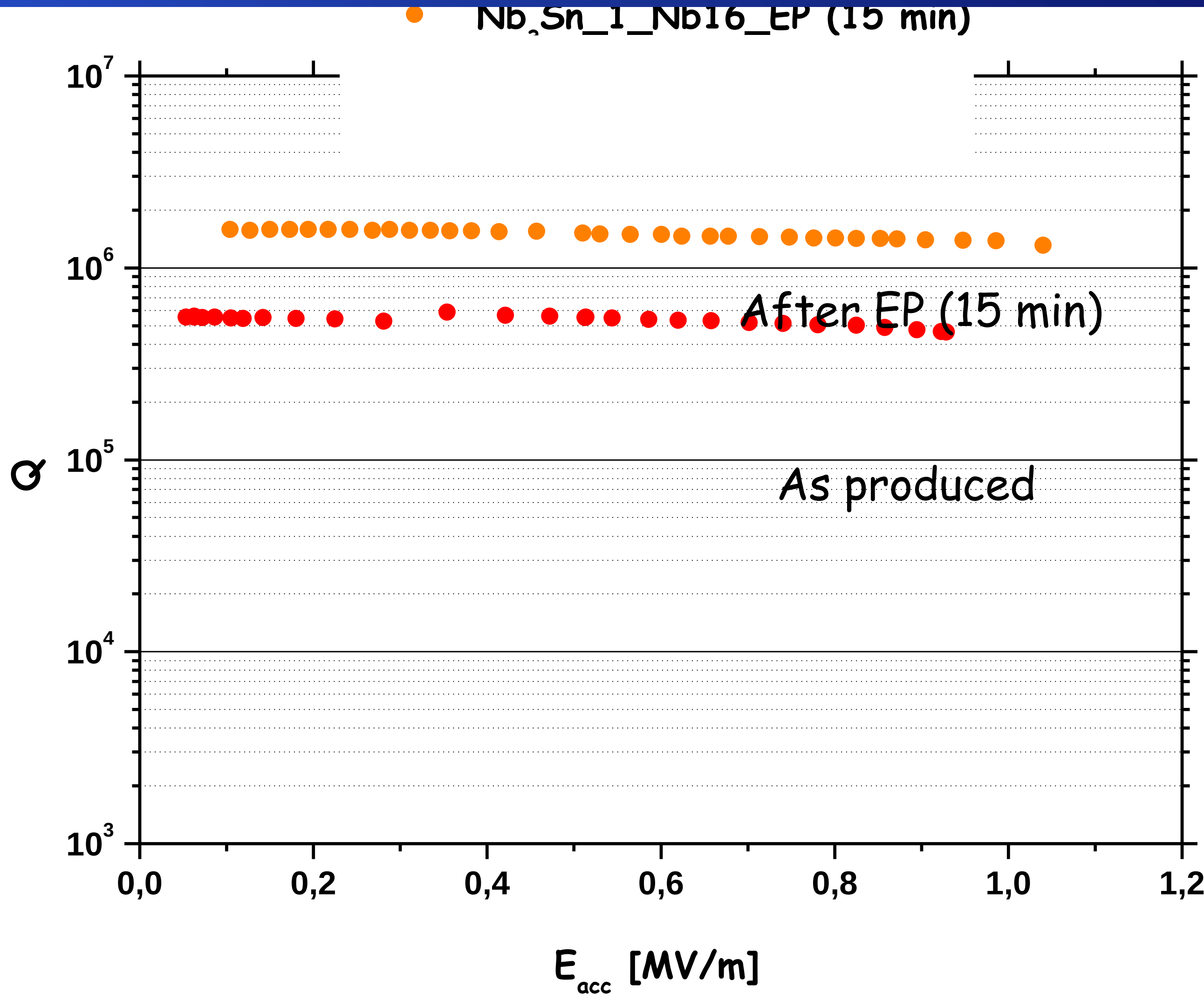
Nb_3Sn CHEMICAL POLISHING



It can be possible to:

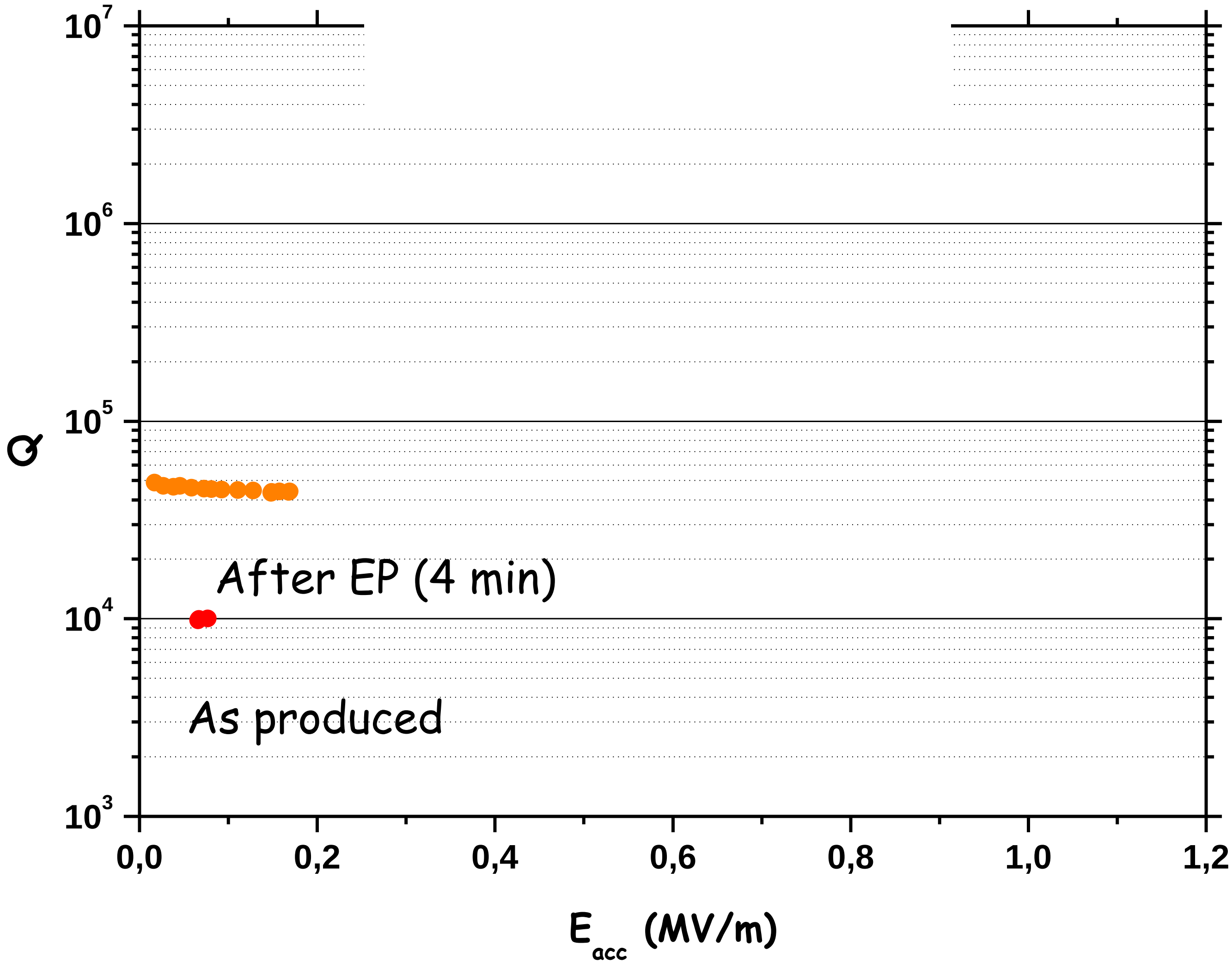
- Get rid of unreacted Sn
- Remove the first Nb_3Sn layer (stoichiometry?)

Q vs E_{acc}



T = 4.2 K, $Q_{BCS}(Nb) \sim 3 \times 10^7$

Q vs E_{acc}



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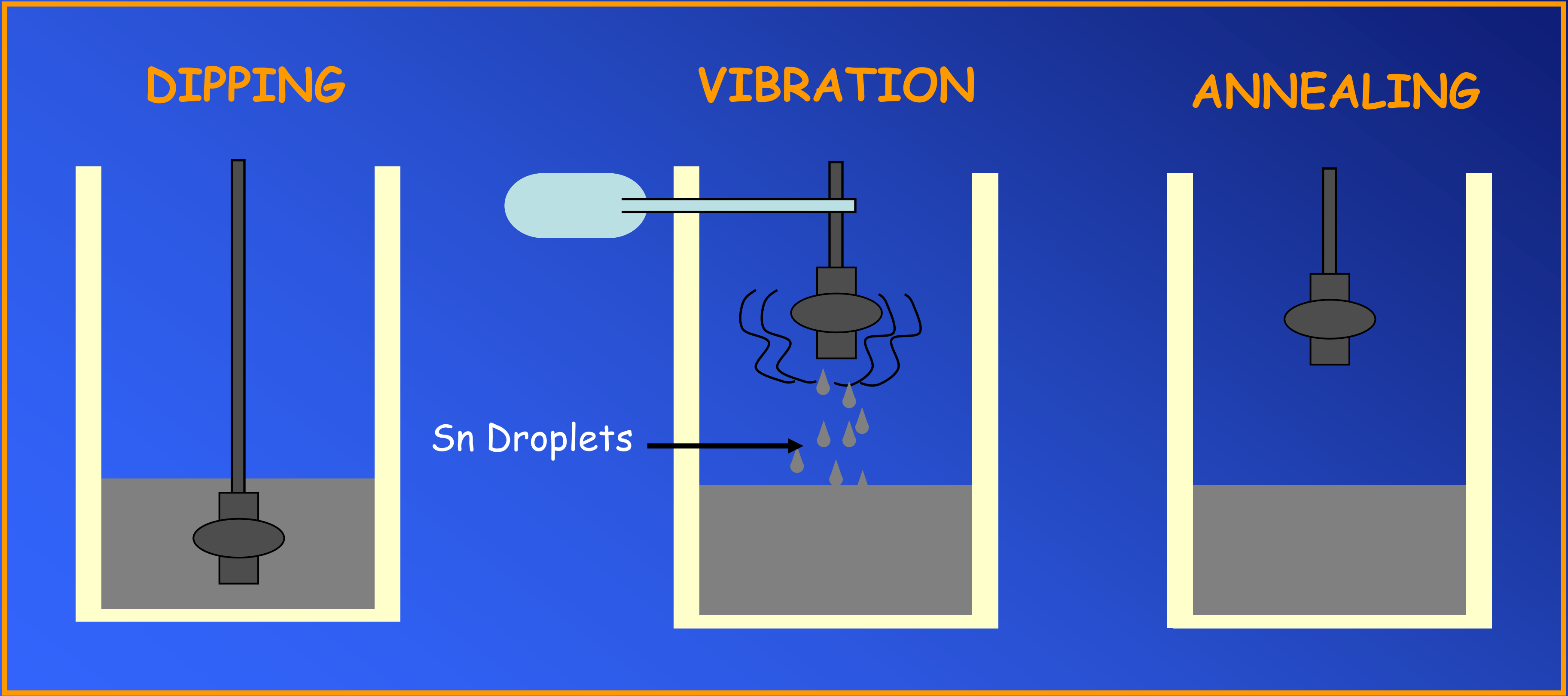
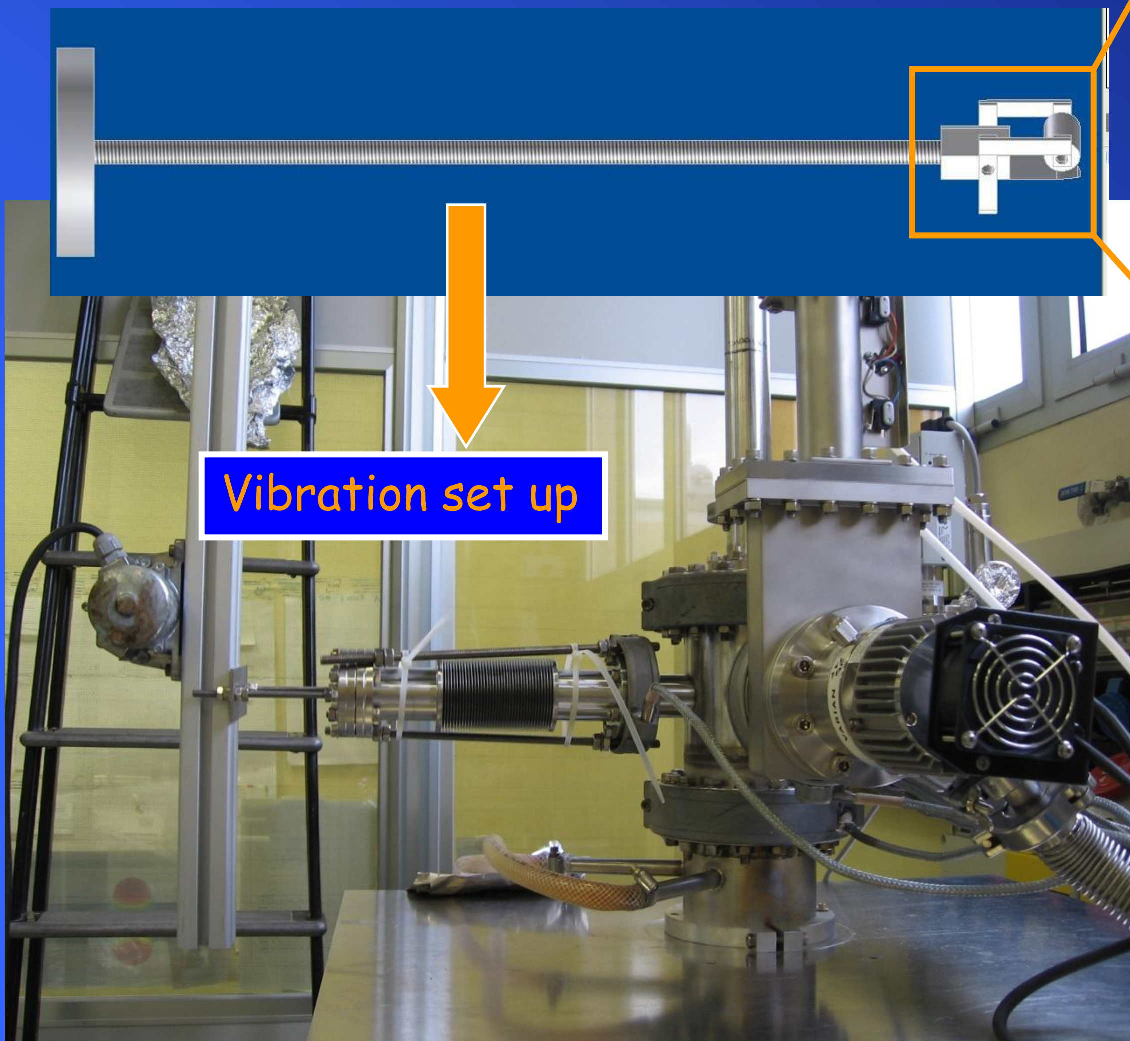
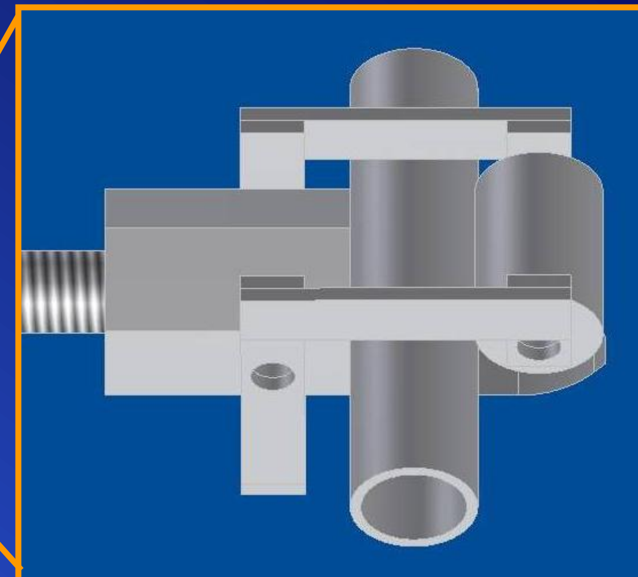
CAVITY VIBRATION



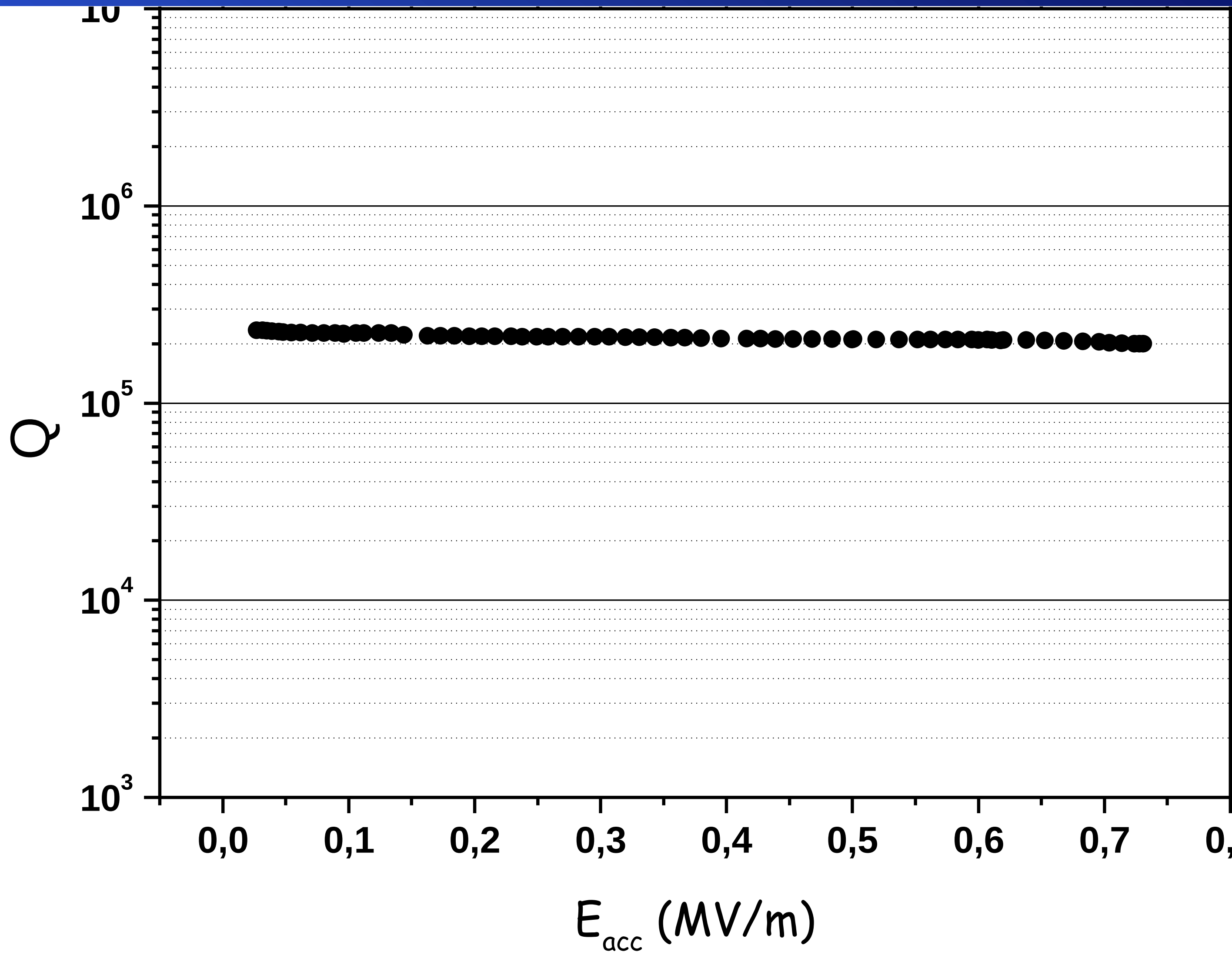
EXPERIMENTAL APPARATUS





Magnetic feedthrough tube

Q vs E_{acc}



T = 4.2 K, Q_{BCS}(Nb) ~ 3 x 10^7

DISCUSSION

- We have a promising way to produce Nb_3Sn
- We have 6 GHz cavites that are easy to produce and test
- We have ideas to try to avoid spurious problems

I would like to profit of this opportunity to

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ask you **suggestions**!

How can we modify the process to improve our results?

Thank you!