

Synthesis of niobium-tin films by Low Energy High Current Electron Beam (LEHCEB) technique

The LEHCEB technique

Secondment at Tomsk Polytechnic University

Period: Spring 2019

Massimiliano bestetti

Aims of the secondment

To learn how it works.

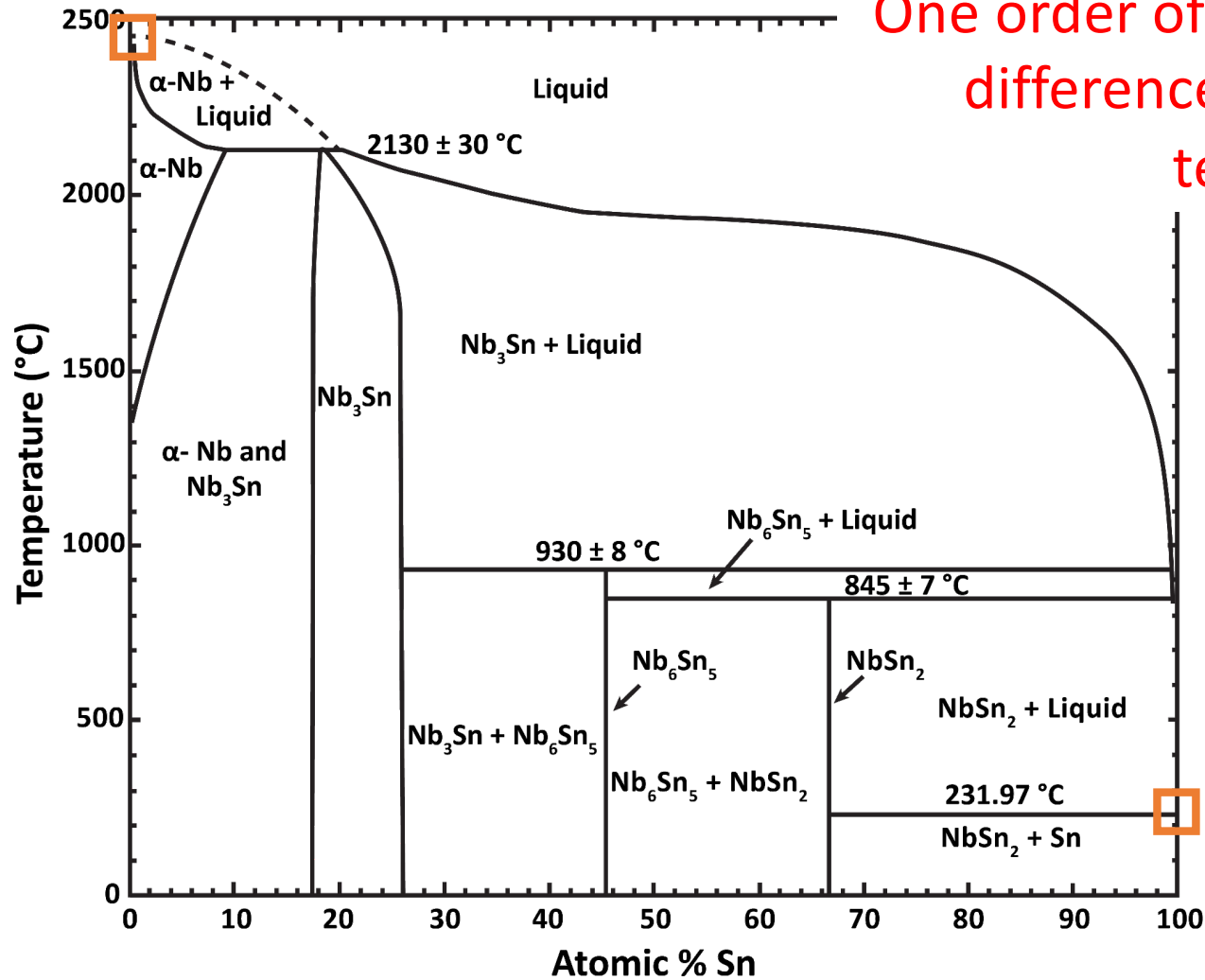
To become familiar with the LEHCEB technique.

To understand if it is possible to produce Nb-Sn films.

Surface alloys are produced by mixing, at the liquid state, metallic substrates with pre-deposited films (by PVD, electroplating,).

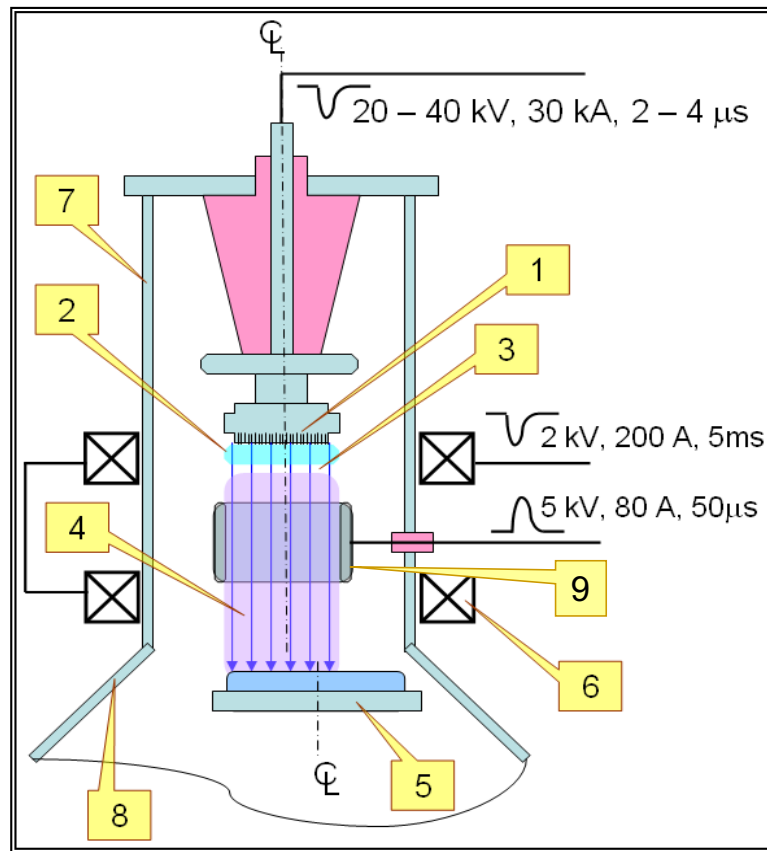
The liquid-phase mixing is carried out by means of a low-energy (≤ 30 keV), high-current (ca. 30 kA) pulsed (0.8 - 3 μ s) electron beams of energy density ranging from 1 to 15 J cm⁻².

2477°C



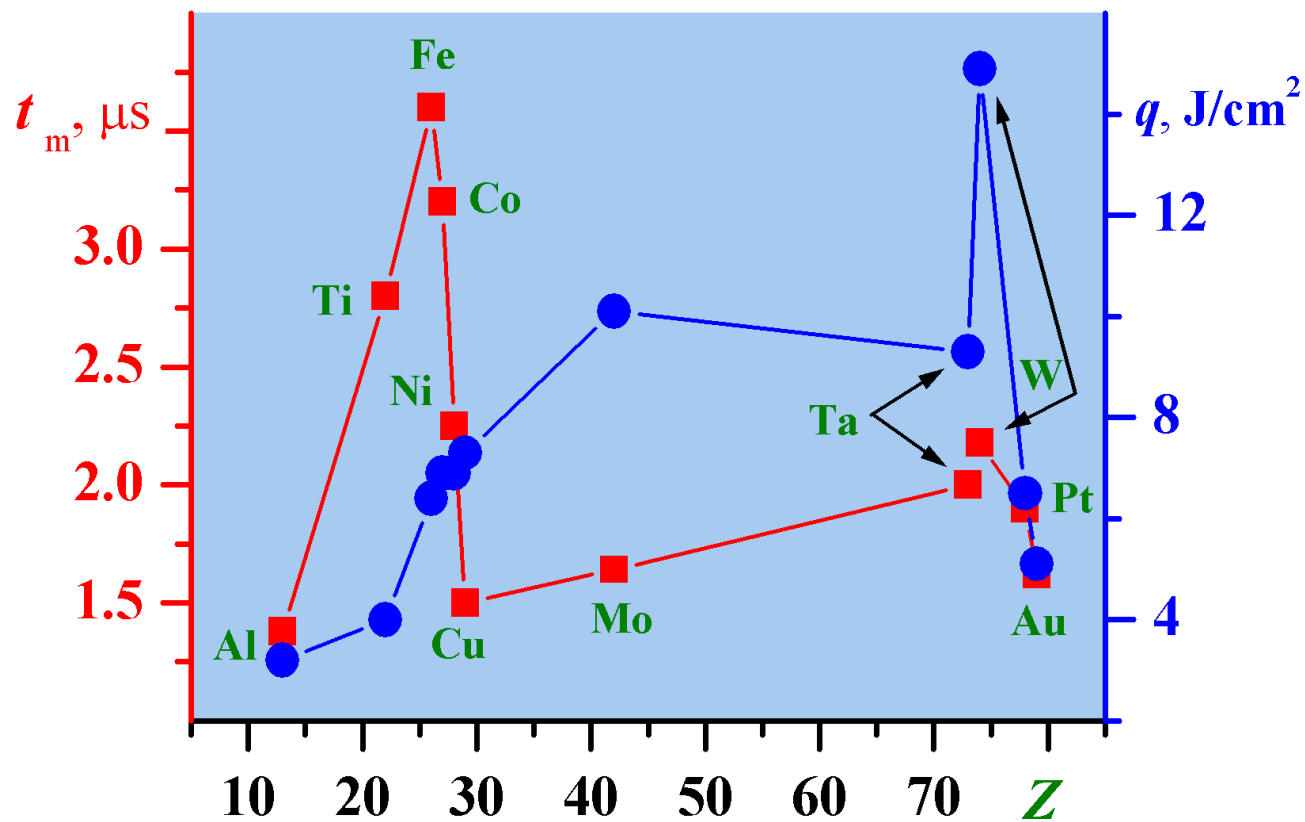
One order of magnitude
difference in melting
temperature

232°C



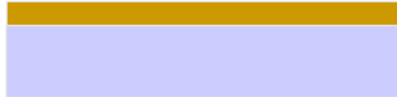
Electron beam is formed at the double layer between cathode and anode plasmas and passed toward the collector inside the anode plasma column.

- (1) Explosive-emission cathode
- (2) Cathode plasma
- (3) Beam accelerating gap (double plasma layer)
- (4) Anode plasma column
- (5) Beam collector (sample holder)
- (6) Solenoid
- (7) Electron gun body
- (8) Vacuum chamber
- (9) Anode.

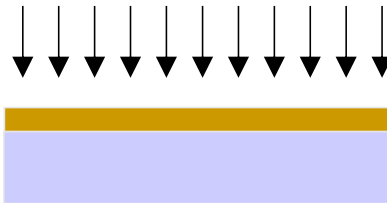


Energy density q corresponding to 3 μm melt depth and lifetime of the melt t_m for various metals

Film
deposition



E-beam melting
and mixing

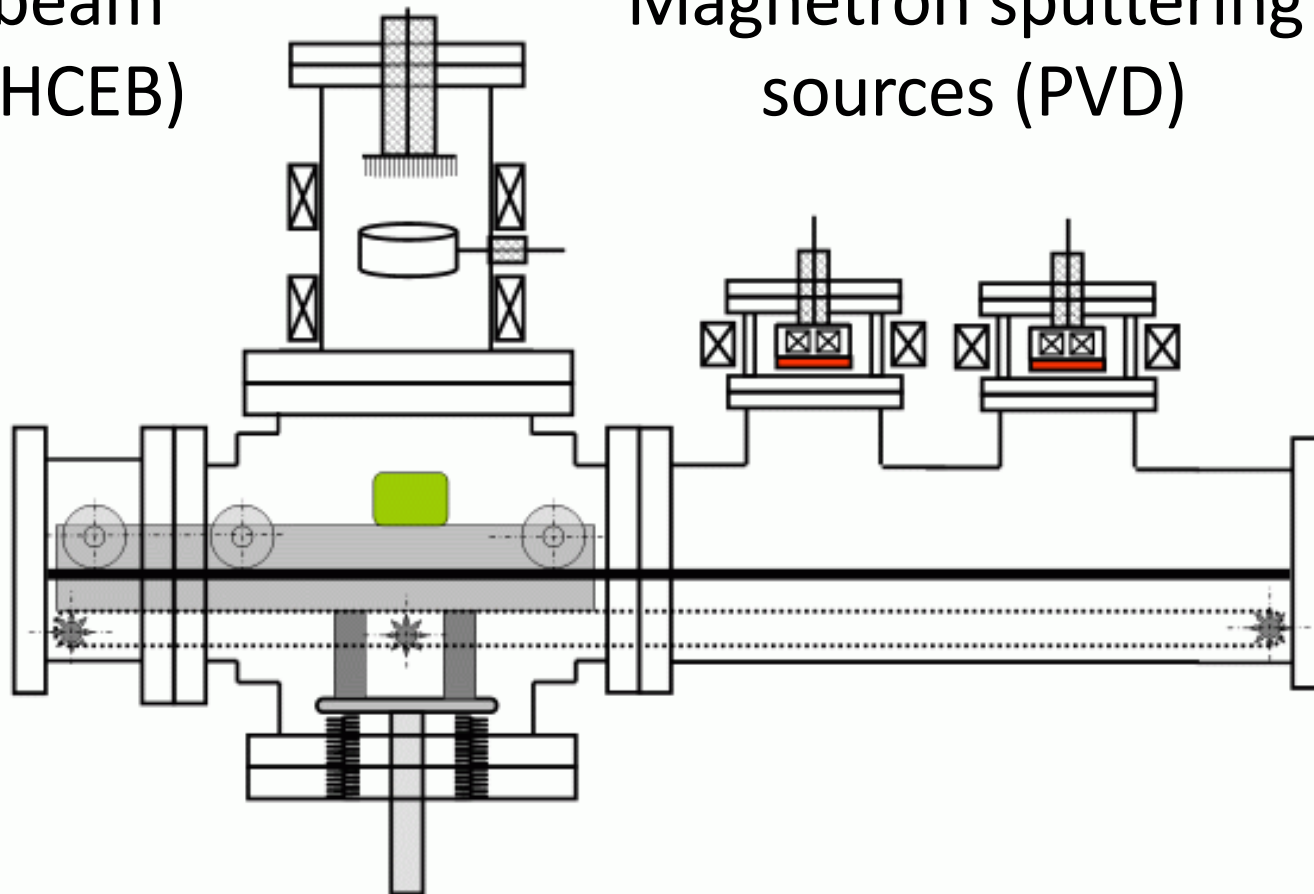


Solidification in
a surface alloy



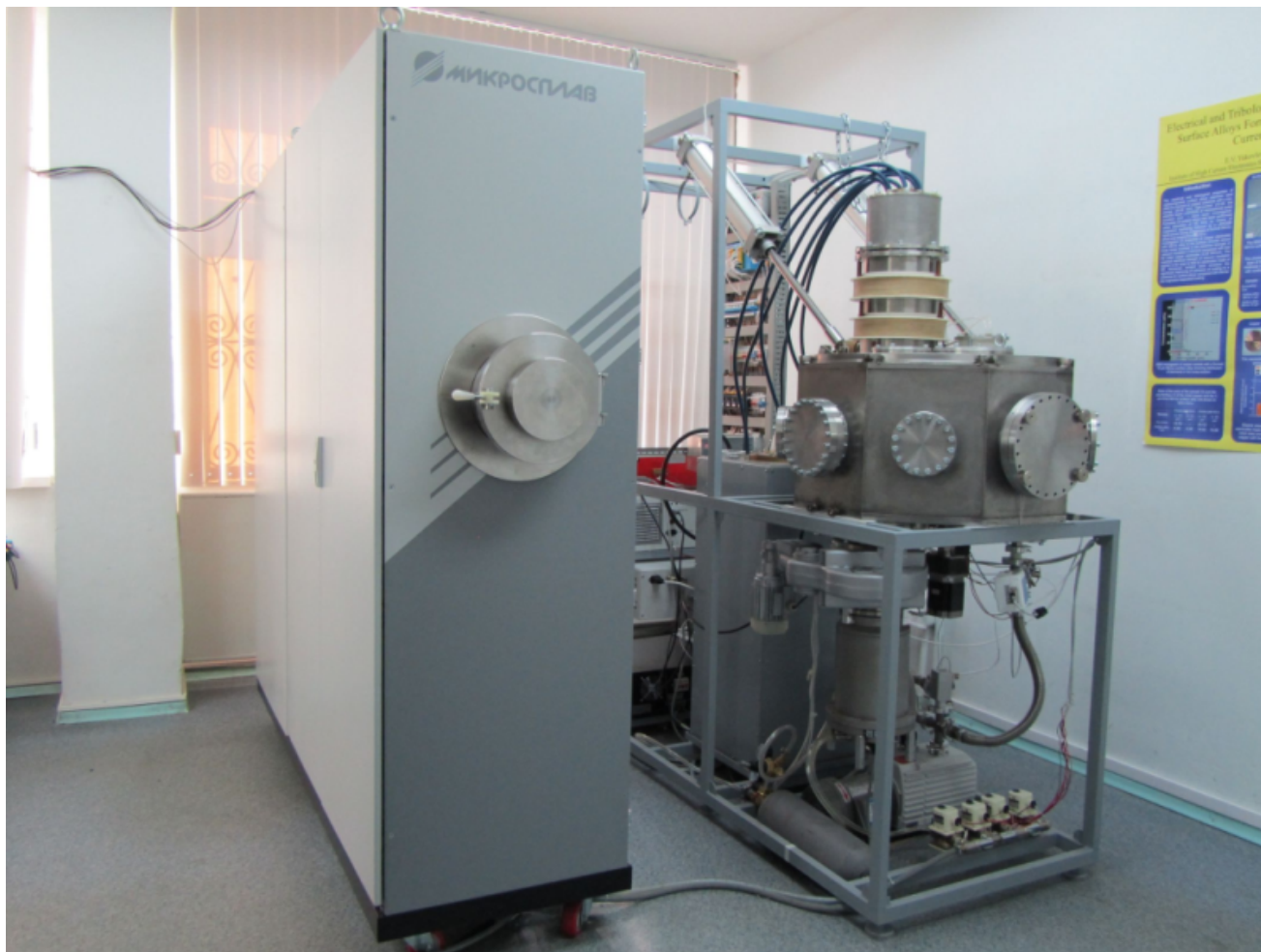
E-beam
(LEHCEB)

Magnetron sputtering
sources (PVD)



Electron energy	up to 40 keV
Pulse duration	1 to 5 μs
Beam current	up to 30 kA
Beam diameter	up to 10 cm
Beam energy density	up to 15 J cm ⁻²
Beam repetition rate	up to 0.2 Hz
Working gas (argon) pressure	0.3 - 1 mbar

Beam acceleration voltage is not high, which meets the requirements for lead-free radiation protection, reliability and low cost in comparison with high-energy electron beams, ion beams and lasers.



The equipment is manufactured by Microsplay «OOO»
(Tomsk, Russia) a spin off company of the Institute of
High Current Electronics of Russian Academy of Science

In the video:

Dr. Alexey Markov

Tomsk Scientific Center



14°
19:05

Следите за новостями на twitter.com/gtrktomsk

РОССИЯ 24
ТОМСК

В суд ушло дело экс-сотрудника томской ИК-3, обвиняемого в получении взятки в 3 тыс рублей

Next secondments

August 2019 and December 2019

Aim: deposition of Sn layers over Nb substrates and electron e-beam alloying to produce Nb-Sn alloys.