FIELD EMISSION PROPERTIES OF THE SC ALLOY (H2B) Nb2V

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1. Introduction

The emission properties of work surface are very important for developing new materials and technologies for manufacturing superconducting cavities of chardge particle accelerators [1-5]. Our first investigation is concerned at this point.

2. Investigated materials

Alloy H2B specimens after manufacturing different metalurgical regimes were undergone to special electrochemical treatment at Federate Problem Laboratory for Technology and Study SSC IHEP. Their emission properties after electrochemical polishing, anodical oxydation [6] and electrochemical refining [7] were studied.

Alloy H2B was produced as ingots and rolleded to sheets from 2 to 3 mm thickness. Federate Problem Laboratory for Technology and Study SSC got eight specimen series after different regimes of cold deformations and annealings.

The annealing temperature influence on properties of cold deformed specimens was studied in the temperature range from 600 C to 1500 C.

3. Technological equipment

For technological treatment of alloy H2B specimens the next installations from Federate Problem Laboratory for Technology and Study SSC IHEP technological equipment complex [8] was used:

- Electrochemical polishing installation
- Anodical oxydation and oxypolishing installation
- Preliminary chemical and thermical treatment division

4. Stand for field emission measurements

The outward appearance of stand for electron field emission measurements is demonstrated at Fig. 1.

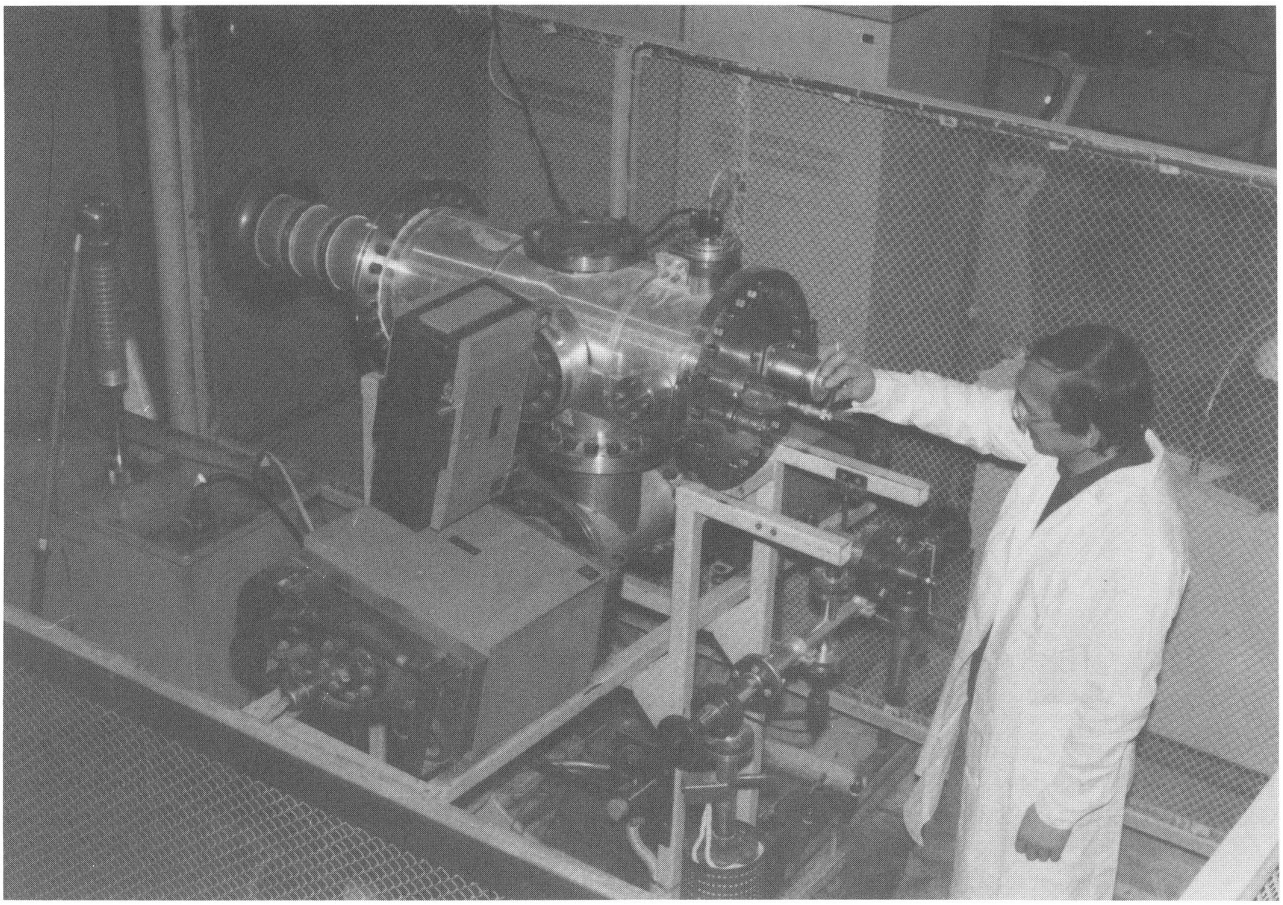


Fig. 1 The outward appearance of stand for electron field emission measurements.

Main stand parameters:

Work chamber diameter	246 mm
Work chamber length	760 mm
Number of specimens, which may be investigated for one pumping cycle	30
Analysed specimen diameter	20 - 50 mm
Work vacuum	10^{-7} Pa
Supplied power	7 kWt

The high voltage lead-in construction enables to apply work voltage by value to 120 kV to adjustable vacuum gap. Vacuum chamber construction and design for transmission of specimens for measurement enable to study electron field emission properties of 30 specimens and to investigate the electrodes of different configuration.

The stand for second electron emission parameters' measurements was described into details at [8].

5. Experimental results

It is important to know not only emission properties but also mechanical ones of new material to be used in acceleration equipment.

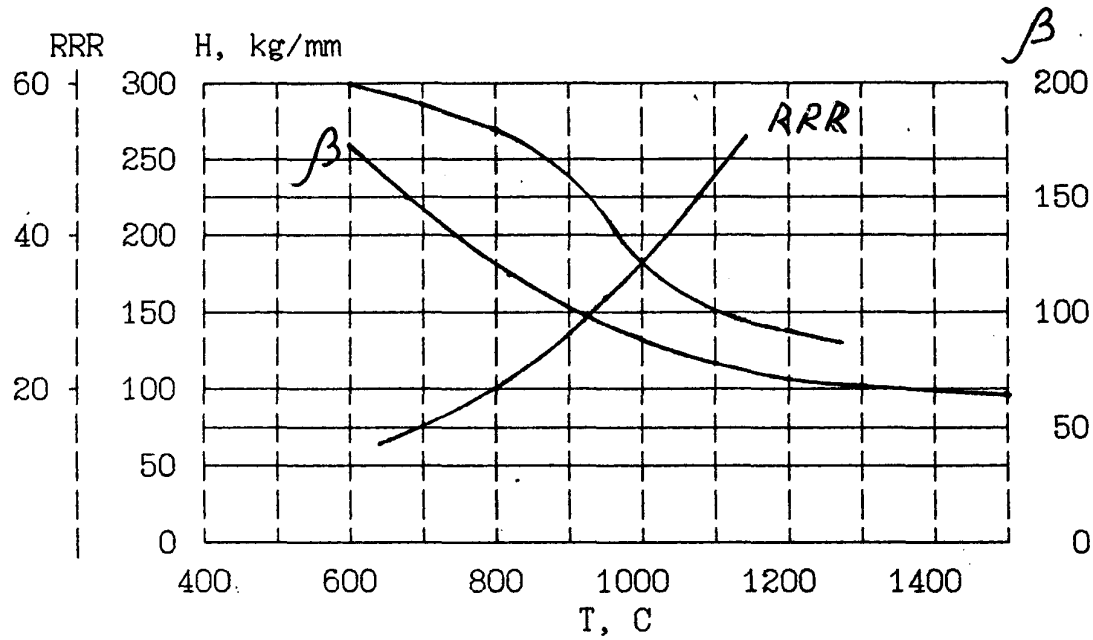


Fig. 2. The dependence of microhardness and field emission currents from annealing temperature.

Tables 1 and 2 contain data on influence of annealing temperature and cold deformation to mechanical properties of alloy H2B.

Table 1

Annealing temperature, C	Strength, kg/mm	Lengthening, percents	Microhardness, kg/mm
600	70	2	250
700	60	3	200
800	50	6	175
900	40	8	140
1100			125
1300			80
1500			60

The duration of each annealing was one hour. The average grain size was 21 micron at 1300 C and 33 micron at 1500 C.

Electrochemical polishing alloy H2B according to [6] with removal of layer by 100 micron thickness ensured good polishing quality only for specimens from series 5, 7, 8. Their surface quality met the requirements to apply for superconducting cavities under aspect of surface microgeometry.

Table 2

Series number	Mechanic. treatment	First anneal. temper. C	Mechanic. treatment	Second anneal. temper. C	Mechanic. treatment	Third anneal. temper. C
1	cold def. 50 percent	-	-	-	-	-
2	cold def. 50 percent	1100	-	-	-	-
3	cold def. 50 percent	1100	cold def.	-	-	-
4	cold def. 50 percent	1100	cold def.	1000	-	-
5	cold def. 50 percent	1200	cold def.	1200	cold def.	1200
6	cold def. 15 percent	1200	cold def. 50 percent	-	-	-
7	cold def. 15 percent	1100		-	-	-
8	cold def. 15 percent	1250		-	-	-

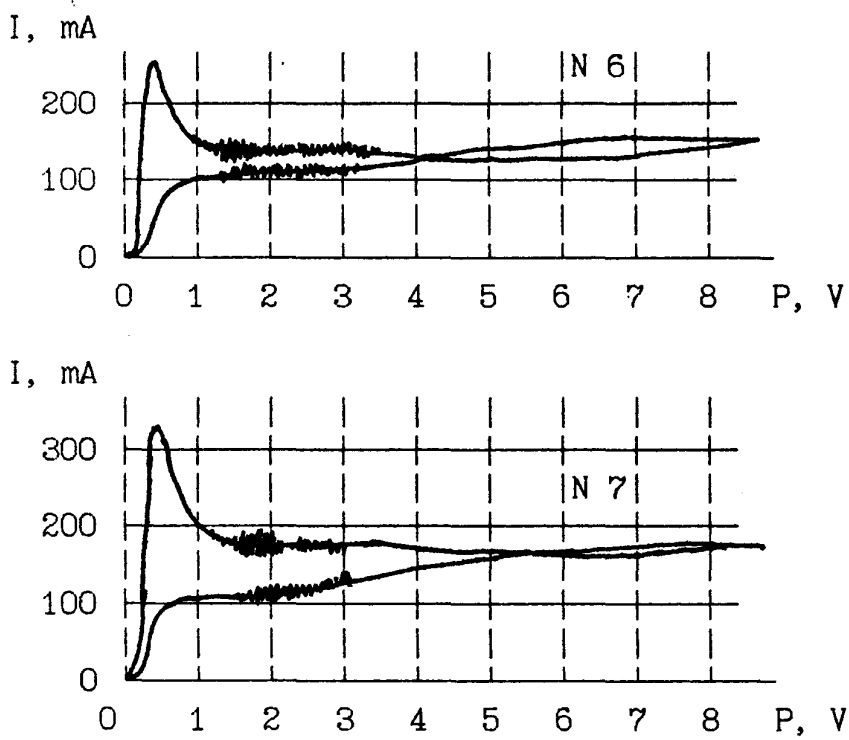
The dependence of microhardness and field emission currents (at conventional values) of polished alloy H2B specimens surface from annealing temperature is demonstrated.

The good correlation between the microhardness of alloy H2B specimen work surface and its emission properties is showed at the Fig. 2.

It is needed to note that alloy H2B specimens even after rough electropolishing without precise one with using oscillation "pockets" [6,9] had emission properties at the level of the best niobium specimens after full treatment cycle (the rough and precise electrochemical polishing, oxypolishing).

By using the express-control method of work surface emission properties of niobium and combinations and alloys on its base, which was developed earlier [9], the comparison of specimens from parties 6 and 7 was conducted. The data showed at Fig. 3, demonstrated the obvious advantage of specimens from series 7 in comparison with ones from series 6. Besides the hysteresis loop square for all alloy H2B specimen parties were significantly less than the ones for niobium. This fact pointed to a lesser alloy emission capability.

The critical temperature of specimens from different series which was measured at GIREDMET and IHEP for different specimen series was set in the range of 8.62 - 9.51 K.



N2 Y

Fig. 3. The hysteresis loops of alloy H2B specimens from parties 6 and 7.

The scattering of critical magnetic field value of alloy H2B specimens from all eight series is showed at Fig. 4.

The electron second emission measurements did not show the advantage of alloy H2B in comparison with niobium.

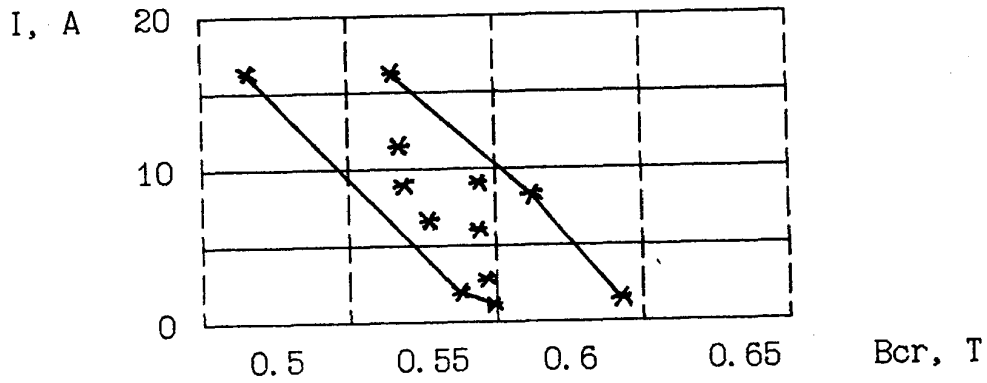


Fig. 4. The scattering of critical magnetic field value of alloy N2V(H2B) specimens.

6. Conclusion

It is planned to manufacture cavities for frequency of 3 GHz "TESLA-shape" to study their work at high level of radiofrequency power. It is needeed to determine the possibility of alloy H2B to be used in superconducting cavities technology.

7. Referances

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