

Niobium Stannide Stability in Halide Melts Containing Tin and Niobium Ions

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Thin coatings of niobium stannide with the crystal structure of A-15 (Nb_3Sn) are employed in various superconducting devices. One of the advanced methods for the production of such coatings is electrochemical reduction from molten salts [1-3]. Among other valuable features this method incorporates the possibilities of purifying the superconducting material from undesirable impurities favourably simultaneously with the process of coating deposition and exercising express control of the layer thickness on intricately shaped surfaces.

This paper deals with stability of Nb_3Sn compound in working halide melts containing niobium and tin ions.

Experiments carried out by holding Nb_3Sn electrode in E- SnCl_2 or E- K_2NbF_7 melts, where E is the CsCl-KCl-NaCl eutectic. In general, the hardware and the reagents, as well as their preparation corresponded to those employed earlier [4-6].

As the result it was found that Nb_3Sn immersion into an electrolyte containing Sn (II) ions shifts the potential from its initial value which achieves, after two regions of slow variation on the chronopotentiometric curve, the potential of tin reference electrode (Fig. 1). This is caused by the reaction of exchange displacement occurring between tin ions and the tested sample. Exposing niobium stannide at 800 K in a melt containing Nb (IV) ions results in a slight decrease of both its weight ($\sim 0.2\text{-}0.4 \text{ mg/cm}^2$) and Nb/Sn ratio. The X-ray phase analysis points to the formation of Nb_6Sn_5 and the changed texture of Nb_3Sn phase (Fig. 2).

The emergence of a new phase is also confirmed by scanning electronic microscopy (Fig. 3). The exposure of Nb_3Sn coatings in the melt brings about smoothing of their microrelief as well as secondary formation of clearly edged Nb_6Sn_5 microcrystals. The changing phase composition is accompanied by changing superconducting characteristics. When one-phase Nb_3Sn layers are exposed in the melt at 850 K and higher, it terminates corrosion; the Nb/Sn ratio within the measurement accuracy is constant and the phase composition remains unchanged. The preserved sample texture suggests increased stability of the A-15 phase.

Thus, the research done has shown that Nb_3Sn compounds is stable in halide melts containing niobium and tin ions at temperature 850 K and higher.

References

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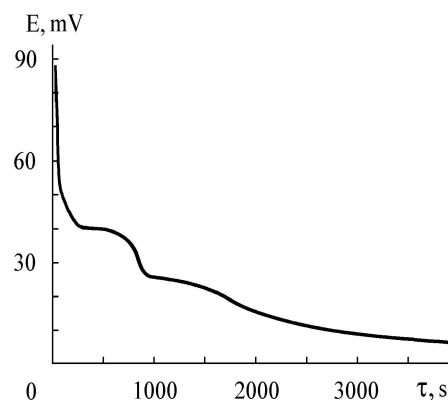


Fig. 1. Variation in the potential of a Nb_3Sn electrode at 800 K in the E- SnCl_2 melts.

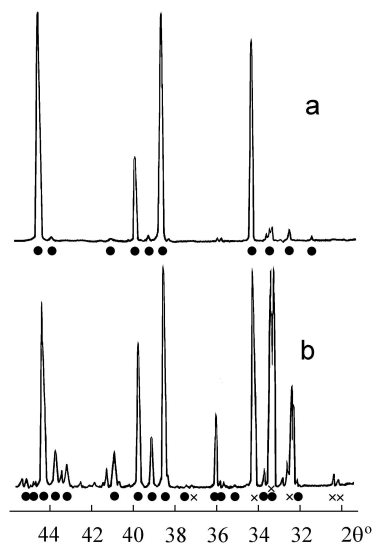
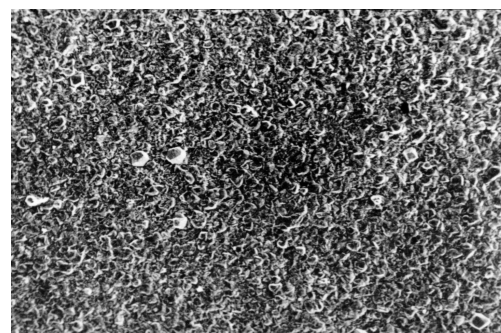


Fig. 2. The XRD pattern for a niobium stannide (a) before and (b) after exposing at 800 K in the E- K_2NbF_7 melts: • - Nb_3Sn , × - Nb_6Sn_5 .



a.



b

Fig. 3. Microstructure of a niobium stannide (a) before and (b) after exposing at 800 K in the E- K_2NbF_7 melts ($\times 100$).