NEW MANUFACTURE PROCESS OF Nb₃Sn WIRE

J. Chen (FSU, Mechanical Engineering); K. Han, P.N. Kalu (NHMFL)

Introduction

As a part of efforts to develop new methods of manufacturing high-strength Nb₃Sn wire, we have explored a new technique that promises to be both simple and fast. Moreover, we expect this new method can be implemented at the NHMFL.

Recently, many new manufacturing methods of Nb₃Sn wire have been developed. Among them, Cable in Tube (CIT) shows a special attraction due to its simplicity. In this method, traditionally complicated manufacture steps are reduced to drawing-cabling-drawing. This method, however, suffered from low density of finishing products. The hot hydrostatic press (HIP) produces high density conductors, but it is complicated and expensive. Recently, we modified CIT in order to avoid the drawback of CIT without losing simplicity.

Experimental

The detail processing steps are shown in Fig.1. The microstructure and magnetization characteristic of Nb₃Sn sample is shown in Fig.2 and Fig.3 respectively.

![Fig. 1. Processing steps in the new manufacture method.](image)

![Fig. 2. Microstructure of Nb₃Sn sample of diameter of 1.12mm in as-drawn condition.](image)

![Fig. 3. The relations of magnetization with respect to temperature of a superconductor wire after the reaction.](image)

Results and Discussion

Figure 2 shows that Nb filaments are well co-deformed with copper. The distribution of Sn rods remains uniform after heavy deformation. Homogeneous distribution of Sn benefits heat treatment to achieve the optimized critical current. No void was found in the materials and therefore the density of the materials is high. The magnetization curve in Fig. 3 indicates that most of Nb was reacted with Sn to form Nb₃Sn phase. The temperature range, where Nb₃Sn transformed from normal state to superconducting state, is narrow indicating that the composition of Nb₃Sn is uniform. Average critical temperature of 16.2K at zero field and zero strain is in good agreement with literature data.

Conclusions

Preliminary examinations of the Nb₃Sn samples made by a modified CIT method show that the properties and microstructure of the wire are promising. Simplicity, efficiency, and inexpensiveness are main advantages of this method.