WBP2-1

The critical current properties of 19-filaments MgB_2 wires by an internal Mg diffusion process

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MgB_2 is considered as a promising candidate for engineering applications in the temperature range of 20-30 K due to its low cost of raw materials and strong intergrain connection. It was found that highly dense MgB_2 wires fabricated by internal Mg diffusion (IMD) have apparently higher current densities than the powder-in-tube (PIT) produced ones. Therefore, IMD also allows a higher engineering current density (J_e), which is one of the most important parameters for practical superconducting systems. We have fabricated 19-filaments MgB_2 wires using an internal Mg diffusion (IMD) process. The microstructure and transport performance of this 19-filaments IMD wire were investigated. For the IMD-processed MgB_2 wire fabricated by C-coated nano-sized B powder with 1.0 mm diameter, the critical current is about 546 A at 4.2 K and 4 T, which is far higher than that of the undoped sample. The best J_e is 6.9×10^4 A/cm^2 at 4.2 K and 4 T. The obtained results show that the C-doped IMD wires with excellent superconductivity and mechanical property can compete with the conventional PIT wires in practical application.

Keywords: Ceramics, Metalic composites, Microstructure, Functional

WBP2-2

Stability Evaluation of MgB_2 Wire Based on Conduction Cooling

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MgB_2 - superconductors have been drawing attention in electric power and magnet applications at temperatures around 20 K. It is also a highly promising alternative superconductor in development of cryogen-free MRI system, thermal stability problem must be addressed in such an application while related studies about MgB_2 magnets or even coils are quite limited. Behavior of MgB_2 wires must be understood before large systems are introduced. Herein, two crucial and fundamental parameters evaluating thermal stability of MgB_2 wire: Minimum Quench Energy (MQE) and Normal Zone Propagation Velocity (NZPV) were theoretically and experimentally evaluated under the condition of self-field at 20K. The experiment was based on cryocooler cooling. As a basis for the thermal stability evaluation, to begin with, critical current was measured by transform method. Output of heater mounted on the wire was used to trigger normal zone propagation in MQE and NZPV measurements.

Keywords: MgB2, Conduction cooling, Thermal stability , Quench

WBP2-3

Post-Annealing Effects of MgB_2 Thin Film Prepared on Stainless Steel Tape

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MgB_2 is an intermetallic superconductor with a high critical temperature (T_c) of 39 K, which leads to an operation temperature of approximately 20 K. We recently reported that high J_c of 6.4×10^5 A/cm^2 at 20 K and 5 T was achieved in the MgB_2 thin film prepared on Si single crystal substrate and then annealed at 550 °C [1]. For the development of practical superconducting wires, MgB_2 films should be deposited on metal tapes. In this study, we prepared MgB_2 thin films on stainless steel (SS304) tape with relatively high mechanical strength.

MgB_2 thin films were prepared on SS304 tapes by an electron beam evaporation technique and about 5 nm-thick Nb layers were deposited on the MgB_2 layers by using a coaxial vacuum arc evaporation gun. The Nb/MgB_2/SS304 specimens were then moved to a sputtering chamber and 1 μm-thick Nb layers were deposited on them for preventing Mg evaporation during the post-annealing process. The post-annealing was conducted at 550 °C for 1 hour under H_2 (3%) + Ar atmosphere to improve the superconducting properties.

The post-annealed Nb/MgB_2/SS304 specimen showed the T_c of 33.5 K and J_c of 1.4×10^5 A/cm^2 at 20 K and 5 T. Crystallinities, microstructures, and interfacial reactions will be also discussed.

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WBP2-4

Research and Development of the LTS and HTS Superconductors at SC "VNIINM"

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SC "VNIINM" is the only developer of the technical low-temperature superconducting strands in Russia especially on the base of Nb_3Sn phase and NbTi alloy. NbTi strands for the Tokamak-7, Nb_3Sn strands for the Tokamak-15, Nb_3Sn and NbTi strands for the ITER, NbTi strands for accelerator NICA, pilot batch of Nb_3Sn strands for the LHC upgrade and other projects were produced in industrial conditions using technologies of SC "VNIINM" and by its scientific support. All the strands produced met technical specifications. At present Bochvar Institute develops layout and production technology of Nb_3Sn strands for FCC. SC "VNIINM" have production technologies of the targets and substrate tapes for the HTS-2 and develops MgB_2 superconductors.
Characteristics of the superconductors developed at SC "VNIINM" for the different projects and also targets and substrate tapes for the HTS-2 are reviewed in the paper. The ways of their current-carrying capacity enhancement are discussed.

Keywords: Nb3Sn, NbTi, strand, HTS

WBP2-5

Influence of Hf diffusion for strain effect of Hf doped Nb_3Sn wires

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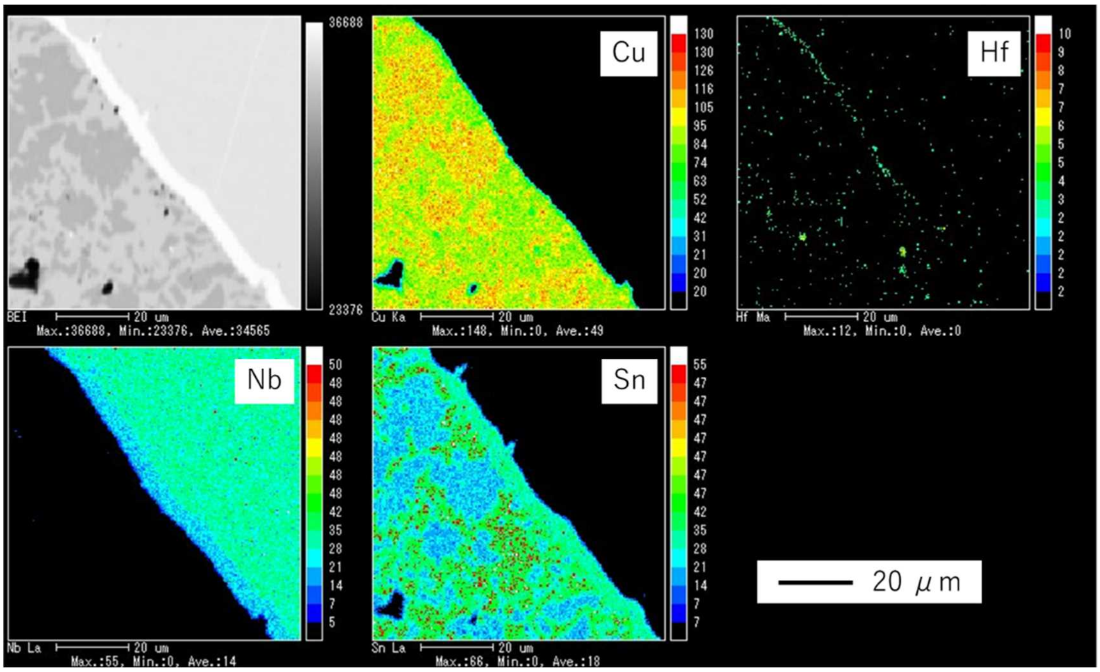
A Nb_3Sn wire have good superconducting properties at high magnetic fields. However, the superconducting properties of Nb_3Sn wires are very sensitive to stress and strain [1]. It is well known that the critical current of Nb_3Sn wires can be significantly increased by third elements addition [2]. The detailed relationship between the strain effect and third elements are not understood.

In this study, the Nb_3Sn wires with the third element were fabricated through Powder in Tube method. Tensile strain dependence of superconducting properties and the element mapping of cross sections for $(Nb,Hf)_3Sn$ wires were measured. 0.5 ,1.0 and 2.0at%Hf Nb_3Sn wires which have 1.5 mm diameter were prepared. Those wires were heat-treated at 670 or 800℃ for 100 h. EPMA composition mapping on the cross section of the 2.0at%Hf doped Nb_3Sn wire with heat treatment of 670 ℃ for 100 h are shown in Fig.1. This result shows that a Hf-Nb-Sn compound was observed at the boundary between the Nb_3Sn and the Cu-Sn-Hf region.



Keywords: Nb3Sn wires, strain effect, diffusion, third element