Composite Superconducting MgB₂ Wires Made by Continuous Process


A. Principles of the Technology

B. Powder Preparation, Feeding and Welding

C. Wire Size Reduction and Twisting of Wires

E. Helium Cooled High Magnetic Field Critical Current Measurements of Wires and Bundles

Abstract—A novel manufacturing technology to produce infinitely long and cost effective composite single core MgB₂ superconducting wires has been developed [1]. The continuous process comprises unique powder feeding technology allowing micron sized Mg and nano-sized B as well as SiC dopant powders to be fed continuously to a “U” shaped metallic sheath material (e.g. titanium, monel). Laser seam welding technology has been applied to seal the conductor seam allowing continuous wire production. Deformation characteristics of wires produced by single and bimetallic sheath materials have been studied. The l(T,B) characteristic of the resulting products has been investigated in a dedicated helium force vapour cooling system at temperatures 20-35K and moderate external magnetic flux density up to 1 T, and also in UHE at high external magnetic flux density up to 9 T. It is demonstrated that the proposed technology provides the possibility of virtually unlimited conductor lengths as well as in-line processing control, ensuring a high degree of reproducibility and consistent quality of the MgB₂ superconductor for large-scale applications. New wire feeding, sealing, reduction and forming technology enable such wires to achieve high engineering critical current density, $J_c$, with typical critical current density $J_c$ of 100 A/mm² and 25.000 A/mm² for doped MgB₂ and undoped MgB₂ respectively.

D. Reactive Diffusion

Conclusions

- It is documented that a novel manufacturing technology to produce infinitely long and cost effective composite single core MgB₂ superconducting wires that effectively can be twisted to “6+1” conductor configuration with twist pitch 26 mm.
- The critical current density after twisting proves to be identical to the critical current density of a single core conductor.
- Development of alternative sheath materials such as mild steel and austenitic stainless steel are in progress to enable cost reduction without degradation of superconductivity and mechanical properties.
- There is also work on improved cryostability of the wires in “6+1” conductor which will be reported in the near future.

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