HIGH FIELD MAGNETS FOR MRI APPLICATIONS

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Introduction

We have proposed that the performance of Bi2212 wire can be improved through the used of magnetic melt processing, which has been shown to increase the degree of c-axis alignment [1,2]. The purpose of this experiment was to demonstrate the feasibility of in-field melt processing as a means of achieving higher critical current with larger filaments in a multifilament Bi2212 wire round.

Experimental

Magnet field processing was performed in the 19 T, 195 mm bore magnet at NHMFL fitted with a furnace capable of heating Bi2212 wire samples to over 900°C. The thermal treatment cycle involved heating the samples to our predetermined peak melt temperature using a controlled ramp rate with an intermediate hold at 500°C., a 12 minute hold at peak and controlled cooling to 820°C. A 12 T background magnetic field was applied at peak temperature and during solidification and initial cooling until a temperature 40°C less than the peak temperature was reached. The total thermal process cycle was approximately 22 hours, while time in-field time was between 0.5 and 0.6 hours. All heat treatments were performed in flowing oxygen. Two Bi2212-Ag sheathed composite wires were evaluated. Wire 1, a 7 x 61 fill pattern with a 34% ceramic fill factor and wire 2, a 19 x 19 fill pattern with a 27% ceramic fill factor. The samples were evaluated by critical current measurements performed at 4.2 K in a background magnetic field up to 5 T.

Results and Discussion

For wire 1, the samples heat-treated without magnetic field had an average I_c = 144 A, while the samples heat treated with the 12 T magnetic field had an average I_c = 173 A. On average, the magnetic field resulted in a 20% increase in performance for wire 1. For wire 2 the samples heat-treated without magnetic field had an average I_c = 110 A, while those heat treated with the 12 T magnetic field had an average I_c = 135 A. On average, the magnetic field resulted in a 23% increase in performance for wire 2. We also attempted to measure the degree of anisotropy in critical current as a means of evaluating magnetic processing effects. The ratio of the I_c for two magnetic field orientations was taken as a measure of anisotropy. In the ideal case, the wires heat treated without magnetic field would have an I_c ratio = 1 for all field values, and the wires heat treated with magnetic field would have a roughly constant ratio < 1 for all non-zero background fields. Our results showed that the wires processed without magnetic field are essentially isotropic, while those samples heat treated with magnetic field, although inconsistent, generally exhibited some degree of anisotropy with one sample exhibiting a ratio of 0.86. The degree of anisotropy in this sample is noteworthy and believed to be significant because it was essentially independent of magnetic field strength.

Conclusions

The results demonstrated the potential for improvement through magnetic processing. We anticipate that as the quality of the wire and in particular its homogeneity improves, the effectiveness of magnetic field processing will also increase.

Acknowledgements

This work was support by the U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute, through Grant No. 1 R44 CA110117-01.

References

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