VARIATIONS IN H_{c2} AND H_{irr} OF DOPED MgB_2 STRANDS WITH T AND J

M. Bhatia, M.D. Sumption, E.W. Collings (MSE, Ohio State University); M. Rindfleisch, M. Tomsic (Hyper Tech Research); S. Soltanian, S.X. Dou (University of Wollongong)

Introduction

It has been shown in the previous experiments that the 4.2K irreversibility field, $\mu_0 H_{irr}$, and upper critical field, B_{c2}, of MgB_2 can be significantly enhanced from the values seem from the binary compound by doping it with SiC [1]. Our results on the Kramer plot extrapolations of the transport Jc data of MgB_2 doped with SiC and ZrB_2 suggest that these enhancements can be achieved even at higher operating temperatures namely (15-20K) [2].

Experimental

Round, 7-filamentary, PIT MgB_2 strands were fabricated by continuous and standard powder in tube methods. Four different strands were made with pure binary MgB_2, MgB_2+10%SiC(30nm), MgB_2+10%SiC (15nm) and MgB_2+7.5% ZrB_2 powders respectively. Also measured were a series of monofilamentary strands with 10% SiC additions. All strands were heated in flowing Ar at temperatures ranging from 640°C to 800°C for a soaking time of either 20 or 30 minutes. Four-point transport measurements were made on 1 cm long samples at the National High Magnetic Field Laboratory in Tallahassee at various temperatures ranging from 4.2K to 20K in a 33 T resistive magnet. The samples were placed perpendicular to the applied field, values of $\mu_0 H_{irr}$ and $\mu_o H_{c2}$ being obtained taking the 10% and 90% transition points.

Results and Discussion

Figures 1, 2 and 3 summarize the results obtained for the variations of $\mu_o H_{c2}$ and $\mu_o H_{irr}$ with temperature for the samples doped with SiC and ZrB_2 dopants. Table 1 shows the current sensing level variation of a series of related mono SiC wires.

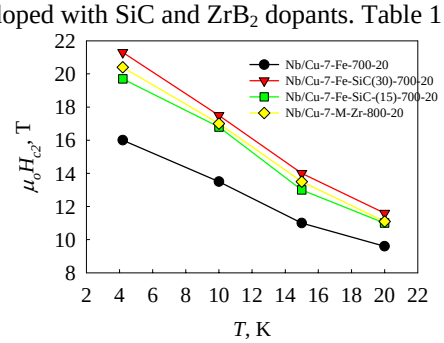

Figure 1

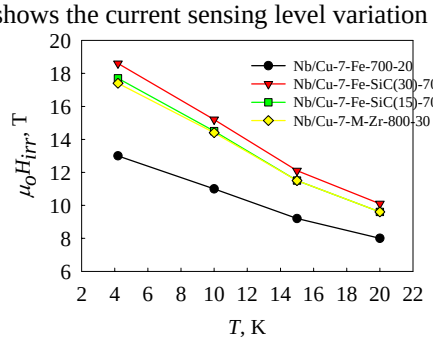

Figure 2

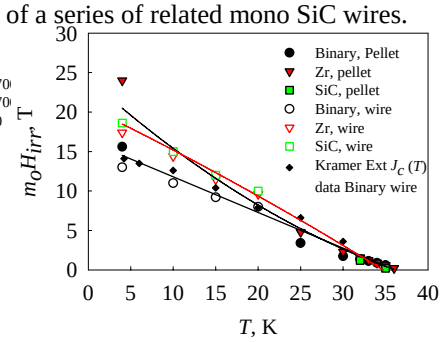

Figure 3

Conclusions

SiC and ZrB_2 dopants increased B_{c2} and B_{irr} in the samples at all measured temperatures. However, significant inhomogeneities appear to be present, and so the increases in B_{irr} and B_{c2} are current measuring level sensitive.

Table 1

Sample Name	1 mA		10 mA		50 mA		100 mA		$\mu_0 H_{irr}$, T	B_{c2}, T
C-640C/30	22.5	26.6	22.4	26.1	21.9	25.6	21.1	25.3	24.2	28.2
D-680C/30			23	26.8	22.5	26.2			27.0	31.2
D-725C/30			25	28.5	24.5	28			≈28	>33
C-725C/30			25.4	29.9	25.4	29.4	25.4	29.9	≈29	>33

Acknowledgements

This work was supported by the U.S. Department of Energy, HEP, Grant No. DE-FGG02-95ER40900.
We thank Dr. Scott Hannahs for his advice and help.

References

[1] Sumption, M.D., *et al*., Appl. Phys. Lett., **86**, 092507 (2005).
[2] Bhatia, M.B., *et al*., Appl. Phys. Lett., **87**, 042505 (2005).