UPPER CRITICAL FIELD AND IRREVERSIBILITY FIELD IN MgB_2 WIRES WITH SIC ADDITIONS

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

Introduction

It has been demonstrated that in some cases the irreversibility field, $\mu_0 H_{irr,}$ and upper critical field, $B_{c2,}$ of MgB_2 can be enhanced from the values seem from the binary compound. This has been most evident in thin film results, with B_{c2} reaching 49 T and even higher at 4.2 K. In the present work we have added SiC to PIT strands, with the intent of C-doping the strands and increasing B_{c2} and $\mu_0 H_{irr.}$

Experimental

Round, monofilamentary, PIT MgB_2 strands were fabricated by continuous and standard powder in tube methods. For strands A and B the powders were V-mixed and then planetary milled. Coarse SiC (200 nm) powders were added during this process in the proportion 10 mol% of SiC to 90 mol% of binary MgB_2 [(MgB2)0.9(SiC)0.1]. Strands C and D were also made from an in-situ route, in this case with 10wt% of "fine" SiC powder (15 and 30 nm). All strands were heated in flowing Ar at temperatures ranging from 640°C to 725°C for 30 minutes. Four-point transport measurements were made on 1 cm long samples at the National High Magnetic Field Laboratory in Tallahassee at 4 K in a 33 T resistive magnet. The samples were placed perpendicular to the applied field, values of $\mu_0 H_{irr}$ and B_{c2} being obtained taking the 10% and 90% transition points.

Results and Discussion

Figure 1 and Table 1 show the B_{c2} and $\mu_0 H_{irr}$ results for strand type B, C and D.

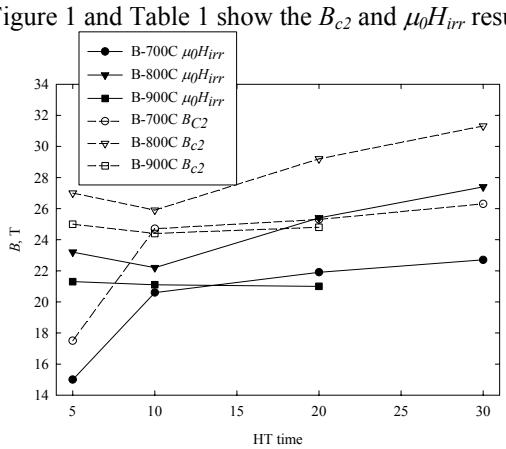

Figure 1. B_{c2} and $\mu_0 H_{irr}$

Table 1. $\mu_0 H_{irr}$ (4.2 K) and B_{c2} (4.2 K) strands C and D (15 nm and 30 nm SiC).

Sample Name	SiC, nm	HT	$\mu_0 H_{irr}$, T	B_{c2}, T
D-640C/30	30	640°C/30 min	26.4	30.4
C-640C/30	15	640°C/30 min	24.2	28.2
D-680C/30	30	680°C/30 min	27.0	31.2
D-725C/30	30	725°C/30 min	≈28	>33
C-725C/30	15	725°C/30 min	≈29	>33

Conclusions

In this work we have presented $\mu_0 H_{irr}$ and B_{c2} for MgB_2 strands with SiC additions made using PIT methods. Strands with finer SiC powders had larger $\mu_0 H_{irr}$ and B_{c2} values. In particular, strands with 200 nm size SiC additions had $\mu_0 H_{irr}$ and B_{c2} which maximized at 25.4 T and 29.7 T for strands heated at 800°C for 30 minutes. The highest critical-field values were seen for a strand with 15 nm SiC additions which after 725°C for 30 minutes had a $\mu_0 H_{irr}$ of 29 T and a B_{c2} greater than 33 T.

Acknowledgements

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