SUPERCONDUCTING PROPERTIES OF SiC DOPED MgB_2 FORMED BELOW AND ABOVE Mg's MELTING POINT

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Introduction

Lack of good sample connectivity has been mentioned as a major reason for not being able to duplicate very high superconducting transport properties of MgB_2 thin film results in the strand and bulk samples. Therefore, it becomes essential to understand the formation reaction mechanism to be able to further improve the connectivity of the reacted strands, achieve sufficient dopant diffusion, and hence to produce wires with better transport properties. Our DSC experiments on MgB_2 suggest that it actually forms before Mg melting in the powder mixture and so we have made an attempt to compare the properties of the MgB_2 strand that was heat-treated below the Mg m.p (i.e. heat-treated at 625 °C) to the one that was heat-treated at higher temperatures. Effects of adding different percentages of SiC and the size of SiC particles were also studied [1]. In this report we present the results of the critical field measurements on these samples.

Experimental

At 4.2 K, B_{irr} and B_{c2} of the SiC doped monofilament MgB_2 strands were determined by resistive transitions under applied fields at the National High Magnetic Field Laboratory (NHMFL) Tallahassee. A four point resistance measurement was performed with 50 mA applied current, and current reversal was used. Measurements were made both in parallel and perpendicular applied fields ranging from 0 to 33 T. Values of B_{irr} and B_{c2} were obtained by taking the 10% and 90% points of the resistive transition.

Results and Discussion

Figs. 1 and 2 show the variation of B_{irr} and B_{c2} of MgB_2 doped with different sizes of SiC in varying percentages and H/T above and below Mg melting temperature. It is clear that 10% doped samples and either H/T temperatures are better than the 5% doped ones. Also, comparing the three different sizes of SiC it can be seen that the small size dopants (30 nm and 15 nm) lead to better properties than 200 nm SiC.

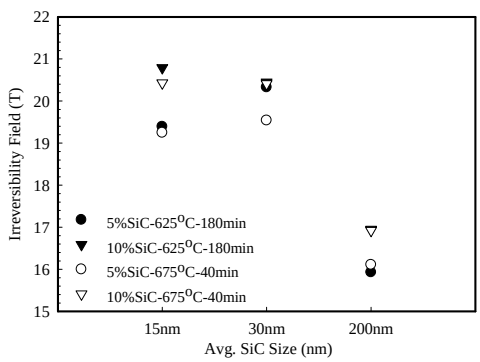

Fig. 1

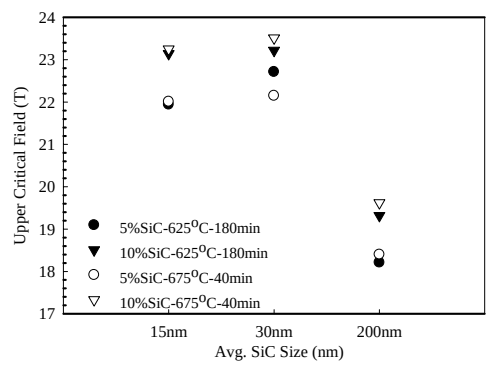

Fig. 2

TABLE 1
10%-30nm SiC doped SAMPLE PROPERTIES

Properties	625 °C-180 min	675 °C-40 min
$B_{c2,\parallel}$ T	24.85	24.45
$B_{c2,perp}$, T	23.66	23.50
$B_{irr,\parallel}$, T	22.46	22.53
$B_{irr,perp}$, T	21.49	21.48
T_c (Midpoint), K	33.2	33.9
ΔT_c, K	0.8	1.7
J_c 4.2K, 5T, A/cm^2	12.7 x 10^4	12.2 x 10^4
J_c 4.2K, 8T, A/cm^2	4.8 x 10^4	4.2 x 10^4
J_c 20K, 5T, A/cm^2	1.6x 10^4	1.27x 10^4
J_c 20K, 8T, A/cm^2	0.6 x 10^3	-

Conclusions

Comparing between the properties of the two H/Ts, the low temperature H/T was found to be slightly better in terms of overall properties.

Acknowledgements

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References

[1] Bhatia, M., Sumption, M.D., *et al.*, submitted to IEEE Transaction of Applied Superconductivity (2006).