Magnetic Processing of Low Aspect Ratio $Bi_2Sr_2CaCu_2O_x$/AgMg Wire

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Introduction

$Bi_2Sr_2CaCu_2O_x$/AgMg conductors are for cryogen-free MRIs operating up to 20 K. One promising approach to increased critical current density is partial-melt processing in the presence of a magnetic field.

Experimental

Low aspect ratio rectangular conductors are processed in an 8 T magnetic field, which was applied during different stages of the heat treatment process. The conductors are electrically characterized as a function of magnetic field and magnetic field angle and the superconductive transition and magnetization hysteresis were measured using a SQUID magnetometer. The microstructures were characterized using scanning electron microscopy and energy dispersive spectroscopy.

Results and Discussion

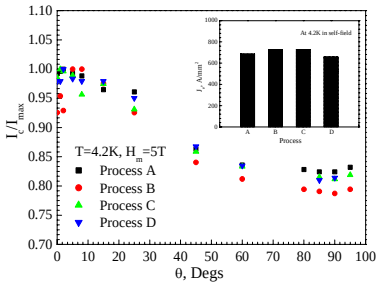

Fig. 1 Transport properties of samples treated without and with the magnetic field versus angle with 5T

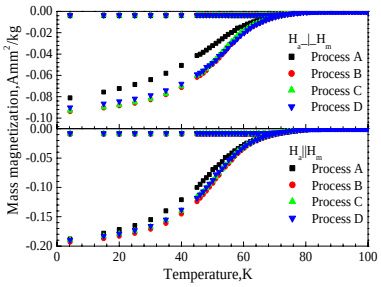

Fig. 2 Superconductive transition for samples treated without and with the magnetic field

Fig. 1 shows transport properties of samples treated without and with the magnetic field. With the magnetic field applied during reaction or reaction and annealing, J_e increased, whereas if the magnetic field is applied during annealing only, J_e is not significantly affected.

Fig. 2 shows the superconducting transitions for samples treated without and with the magnetic field. With the magnetic field during treatment, the transition is sharper. Transition width reflects grain coupling strength. A wide transition indicates that grain coupling is weak at the grain boundaries.

Fig. 3 and Fig. 4 show the magnetization hysteresis and the irreversibility lines of samples treated without and with the magnetic field. With the magnetic field, the magnetization hysteresis and the irreversibility fields were enhanced. Compared with the transport measurements, the anisotropy of the samples were decreased after treatment under the magnetic field.

The magnetic response is caused by intragranular shielding currents as well as intergranular currents. With the magnetic field, the superconductor grains grow with the c-axis parallel to the field direction and so links connecting grains. in the ab plane and the platelets through their large face were improved.

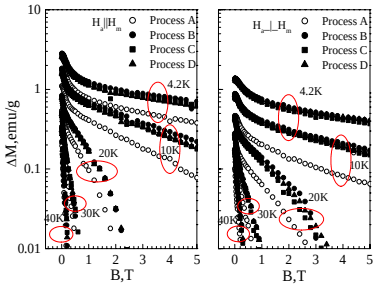

Fig. 3 Magnetization for samples treated with and without the magnetic field

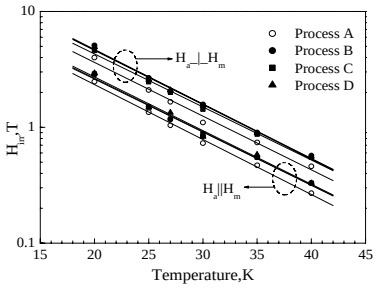

Fig. 4 Irreversibility lines of samples treated without and with the magnetic field

Conclusions

The degree of texture and properties of low aspect ratio Bi-2212/AgMg multifilamentary wires can be enhanced by processing within a magnetic field. Enhancements of grain coupling strength and irreversibility field are shown. Improvements in the magnetic behavior exceed the improvements in the transport behavior.

Acknowledgements

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References

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[2] Ph. Vanderbemden, et al., Physica C, 351, 67-70, 2001