React-Wind-Sinter Magnet Fabrication for Bi-2212 Round Wire

T.M. Shen (FAMU-FSU College of Engineering, NHMFL/FSU); U.P. Trociewitz (NHMFL/FSU); X.T. Liu (NHMFL/FSU) and J. Schwartz (FAMU-FSU College of Engineering, NHMFL/FSU)

Introduction

Bi-2212 round wire is promising candidate for low-temperature and high-field magnet application above 20 T, which exceeds the physical limit of Nb-based low temperature superconductors. Melt processing (MP) has been extensively used to generate high engineering critical current density, J_e, in Bi-2212 conductor. However, present two magnet processes, Wind&React and React&Wind, can not replicate high J_e realized in short-sample. Wind&React (W&R) coil suffers from reaction-related issues such as ceramic leakage, which is induced by inherited high temperature (around 900 ^oC) in oxygen-rich atomosphere with MP. React&Wind (R&W) is stress limited. An alternative approach to magnet fabrication, React-Wind-Sinter (RWS), has recently been proposed to overcome the problems associated with both W&R and R&W. In this process, the conventional Bi-2212 heat treatment is split into two separate heat treatments and the magnet is wound between them (Split melt processing, SMP). Here we report electromechanical behavior of SMP and RWS conductors.

Experimental

Multifilamentary AgMg-sheathed/Bi-2212 round wire in this study has a diameter of 0.8 mm. A macor bending rig was developed to bend the wires into various bending diameter and hold them during the heat treatment to simulate the W&R and RWS [2]. Then the 20 T large bore resistive magnet at cell 4 was used to test the critical currents.

Results and Discussion

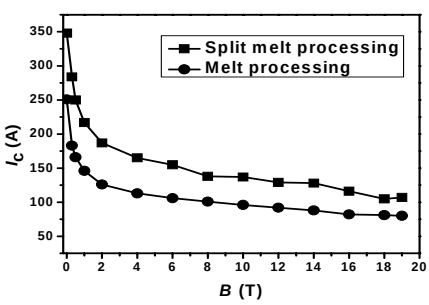

Fig.1 I_c at 4.2 K as a function of magnetic field up to 19 T for two straight Bi-2212 wires processed by MP and SMP

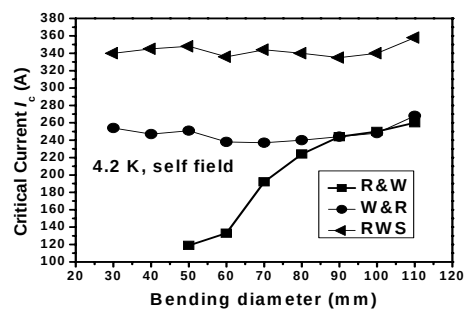

Fig. 2 I_c at 4.2 K, self field as a function of bending diameter for W&R, RWS, and R&W process

Uncertainty with RWS first involves the question of whether SMP produces high J_c in Bi-2212 conductor. Figure 1 shows that a 40% increase in I_c was realized by split melt processing up to 19 T. Straight samples around 4.5 cm were investigated. This indicates that conventional Bi2212 processing is far from optimized, and there is much room for I_c improvement for Bi-2212 round wire. Samples were bent to various diameters between 30 mm to 100 mm at different phases to similar W&R, RWS and R&W. Since the intermediate winding in RWS may cause mirocracks or fracture in filaments, destroying the integrity of grain connectivity, second uncertainty with RWS is whether HT2 in RWS heals intermediate-bending effects. Figure 2 shows that there is no strain-induced degradation even at a bending diameter of 30 mm, indicating that RWS has similar strain-state as W&R process.

Conclusions

J_e of Bi-2212 round wire was significantly improved through a novel split partial-melt processing. RWS conductor was shown to have robust mechanical property, indicating that SMP and RWS can be appealing option for Bi-2212 technology.

Acknowledgements
This work is supported by National Institute of Health under STTR. Supercon, Inc is thanked for providing conductor.

References
[1] Schwartz, J., *et al*., *Superconductor Science and Technology*, **20**, L59-L62 (2007).
[2] Shen, T.M., *et al*., will appeared in *IEEE Transaction on Applied Superconductivity* 2008