INITIAL STUDIES TOWARDS REACT-WIND-SINTER PROCESSING OF $Bi_2Sr_2CaCu_2O_{8+x}$ CONDUCTORS FOR HIGH FIELD MAGNETS

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Introduction

AgMg sheathed $Bi_2Sr_2CaCu_2O_{8+x}$ (Bi2212) conductors have great potential for future high field magnets [1] but an effective manufacturing approach is needed as there are serious issues associated with both react&wind (R&W) and wind&react (W&R) technologies. R&W is limited by the amount of critical strain margin that is taken by the bending strain, while W&R is limited by its restrictive heat treatment process that leads to inhomogeneous behavior and core leakage problems. Here we report on "react-wind-sinter" (RWS) approach to manufacturing Bi2212 coils. In this approach, which was first proposed in 1997 [1] and is now studied for implementation into high field coils, the conductor is initially heat treated as if pursuing R&W, but the heat treatment is interrupted, the coil wound, and the heat treatment then continued, emulating W&R. In this way, the partial-melt portion of the heat treatment is accomplished before tightly winding the coil, and winding stress is relieved by post-winding heat treatment.

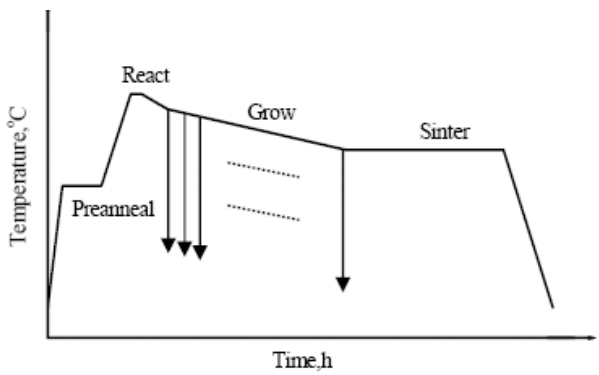

Figure 1: Heat treatment variations for studying RWS .

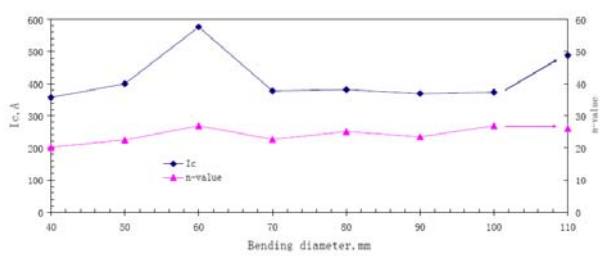

Figure 2: Critical current and n-value versus bending strain for wires that were bent between the react and grow steps of the heat treatment.

Experimental

Fig. 1 shows the temperature-time heat treatment profile for Bi2212 wires. The heat treatment is broken down into three steps: partial-melt reaction ("R"), growth ("G") and sintering ("S"). The downward arrows indicate possible locations for interrupting the process for RWS processing. To emulate the RWS process using short samples, a macor sample holder with a series of bending diameters was machined, facilitating bending short samples of wires to bending diameters as small as 40 mm. Short samples were heat treated for part of the conventional process, interrupted, bent into the macor sample holder to emulate winding, and returned to the furnace to complete the heat treatment. Samples were then electrically characterized to determine if the critical current of straight wires is obtained in RWS wires. All I_c measurements were made at 4.2 K, self-field, using a four-point method with a 1μV/cm electric field criterion.

Results and Discussion

Results for a 0.78 mm diameter Bi2212 wire are shown in Fig. 2. The data point at a 110 mm bend diameter is actually for a straight wire; the use of "110 mm" is for graphing convenience. It is seen that there is no loss of electrical performance due to the interruption of the process and bending. The data in Fig. 2 is for samples that were interrupted immediately after the "R" step, which is most favorable for healing bending stress.

Conclusions

Initial experimental results towards a RWS manufacturing process are favorable. Additional experiments on small coils and to determine the effectiveness of the process for relieving bending stress are planned.

Acknowledgements

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References

[1] S. Boutemy, J. Kessler, and J. Schwartz, *IEEE Trans. Appl. Supercond.* **7**(2), 1552-1555 (1997)