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Performance of MgB_2 Superconductor Developed for High-efficiency Klystron Applications

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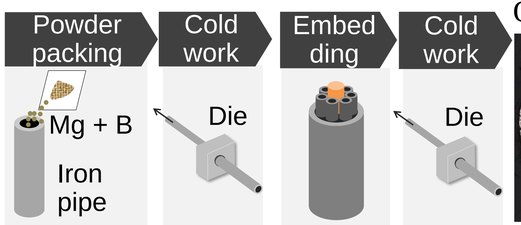
1. Introduction

- The beam focusing magnet for Klystron use with NbTi wire was operated with 6 kW AC plug power for cooling [1].
- MgB_2 has 39 K as T_c [2] and great potentials to realize the high-efficiency magnet for Klystron use [3].
- It is important to reduce the heat penetration from RT to low temperature (superconducting coils) for high-efficiency, and the current leads of the magnet should be finer [4].
- We need two reels of 2.9-km long MgB_2 wires for power saving, because the rated current is small as 57.1 A.
- In this paper, we made and have evaluated an 8-km long MgB_2 wire for high-efficiency klystron magnet.

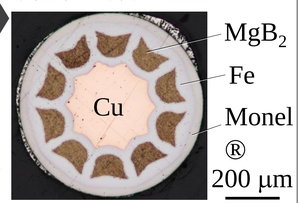
2. Experimental Details

Wire preparation



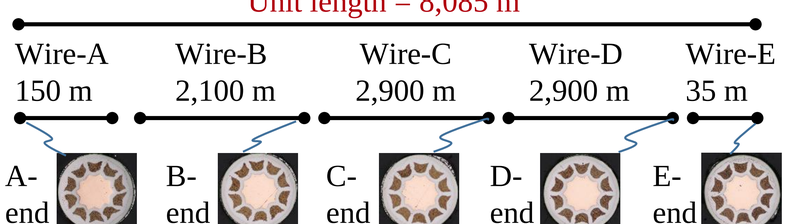
Cross-section

O.D. = 0.67 mm



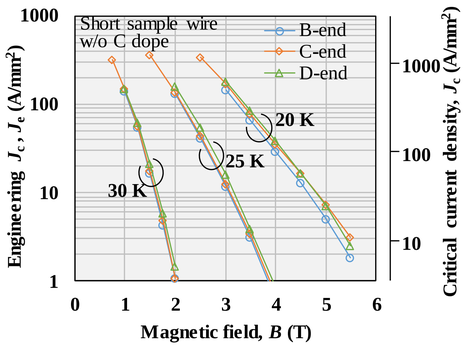
Separation of 8 km long MgB_2 wire

Unit length = 8,085 m

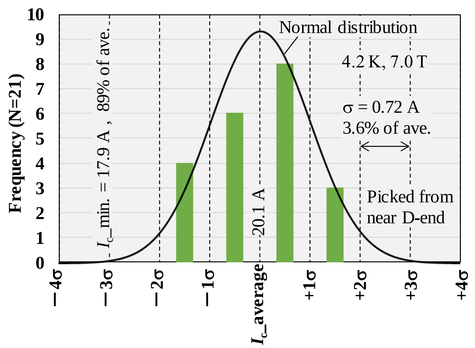


3. Evaluation of critical current and homogeneity

J_e (J_c) –B–T every 2.9 km sampling



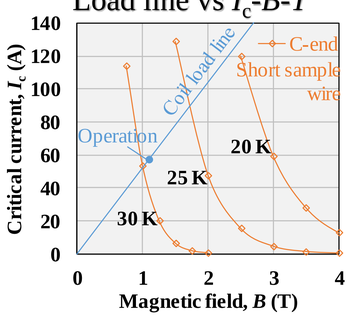
I_c distribution every 70 mm sampling



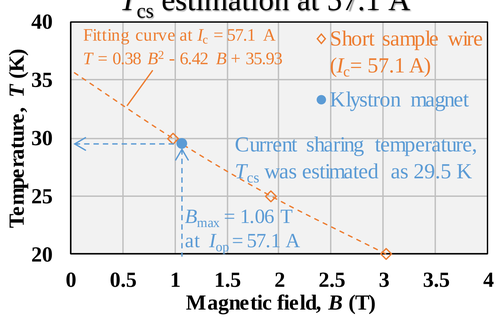
Evaluation as the *Wind & Reacted* magnet

two reels of 2.9-km long wires (Wire-C and Wire-D)

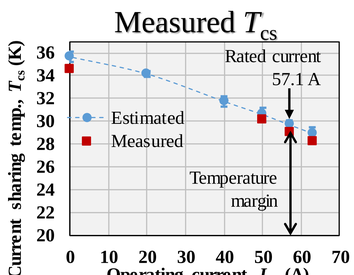
Load line vs I_c-B-T



T_{cs} estimation at 57.1 A



Measured T_{cs}



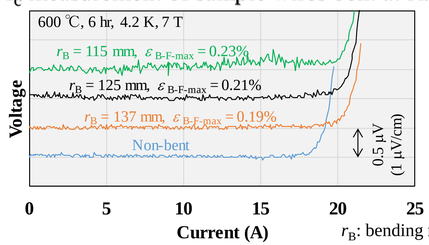
- Measured current-sharing-temperature, T_{cs} of the magnet agreed well with the estimated value from the short sample wire's I_c-B-T.
- It means this wire has good homogeneity across 2.9 km long x 2 reels.

4. Discussion: *future work*

Q: Can the magnet be made by *React & Wind* ?

A: Yes, the critical bending radius is 137 mm [5].

I_c measurement of sample wires bent at R.T.



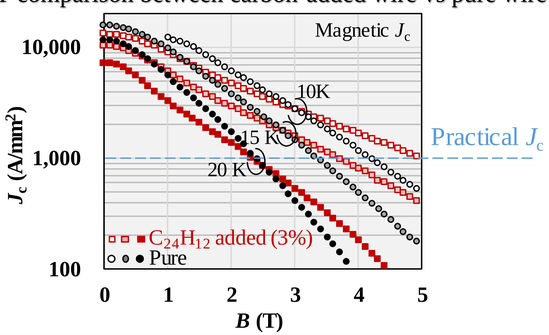
r_B: bending radius

$\varepsilon_{B\text{-}F\text{-}max}$: Max. strain on filaments

Q: Can MgB_2 magnets make higher magnetic field?

A: Yes, we can select carbon-added wire [6].

J_c-B-T comparison between carbon-added wire vs pure wire



5. Conclusion

- The performances of the 8-km long MgB_2 wire were good enough for making klystron magnet by *Wind & React* method.
- Next opportunity for another klystron magnet, we will make it by *React & Wind* method.

[1] S. Yokoyama, *IEEE TAS* (1996) 2633, [2] J. Nagamatsu, *Nature* (2001) 63, [3] A. Yamamoto, *in this conference* (Wed-Af-Po3.15-08), [4] H. Watanabe, *in this conference* (Tue-Af-Po2.23-05), [5] H. Tanaka, *IEEE TAS* (2019) 8401104, [6] M. Kodama, *SuST* (2017) 044006