Development and Testing of Electrical Joints for the 36-T Series-Connected Hybrid Magnet

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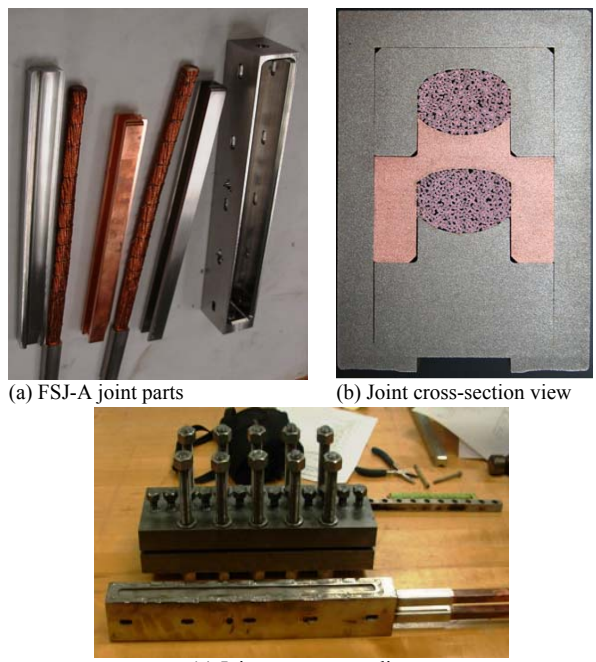
Introduction

The superconducting outsert of the 36-T SCH magnet consists of three concentric layer-wound subcoils using different grades Nb_3Sn Cable-in-Conduit-Conductors. The splices and terminals of the subcoils are designed to be placed outside the 36-T SCH (approximately 0.75 m in radius) and aligned with the magnetic axial field. The cryogenic budget for each joint at normal running mode is 0.8 W, which requires the joint DC resistance to be less than 2 nΩ. Here, we report the research effort to design and test the first prototype joint sample using 45-T hybrid magnet coil-A cable [1].

Joint design

The design philosophy of the 36-T SCH joints is simple, robust and well balanced between DC resistance and AC losses according to its mission. Following this guideline, we designed and manufactured the first sample joint based on the Florida Solder-less Joint Technology (patent pending). The joint is enclosed in a stainless steel joint box entirely as shown in Fig. 1. The superconducting cables are compressed in the joint assembly against the OFHC copper plate at the middle. The strands and the copper plate are sintered together during the first stage of the heat treatment, which provides a good current transfer without bearing a large penalty in AC losses.



(a) FSJ-A joint parts (b) Joint cross-section view

(c) Joint compress tooling

Fig 1. FSJ-A sample joint

Results and Discussion

The joint has been tested at 4.2 k saturated helium bath without background field. The transport current was feed to the joint by a pair of vapor cooled current lead. The joint resistance is obtained by measuring voltage drop across. The results show that the joint resistance is less than 1.7 nΩ at 19.5 kA. The current distribution along the joint has been measured by Hall sensor locally at two places. The results agree well with the model developed.

Conclusions

The concept joint design for the SCH has been finished. A prototype joint sample FSJ-A has been successfully fabricated and tested. The DC resistance of the joint is below the maximum allowed design value (2.0 nΩ). Manufacture of a full size joint sample to be tested in magnetic field is on schedule.

Acknowledgements

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References

[1] Painter, T.A., *et al*., IEEE Trans. Magn, **30**, 2204-2207 (1994)