A 9 T Cryocooler Cooled High current density NbTi superconducting magnet

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Introduction

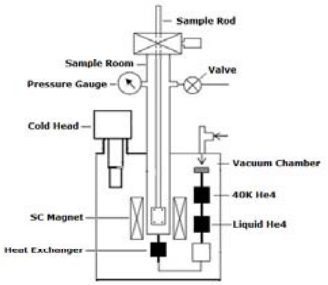
Cryocooler cooled superconducting magnet systems have the advantage of simple and low cost operation. This work presents the design and test results of the cryocooler cooled 9 T superconducting magnet. The magnet system was design for superconducting material measurement. It has a variable temperature space (4.2-300 K). Three types of NbTi superconducting wires were used for the superconducting magnet design. The magnet has compact size. The bare wire diameter in outer winding is 0.4mm. It has high current density if a quench happened. So the magnet need a good quench protection. In order to improve the homogeneity for central field the structure of outer winding need to be adjusted.

Conclusion

- A 9 T Cryocooler Cooled NbTi superconducting magnets was developed.
- The homogeneity of central field was better than 0.1% homogeneity over a 10 mm diameter and 15mm length region by means of decreasing the ampere-turns in the middle of the coil.
- The cool down time from room temperature to operating temperature is 15 hours.
- The maximum engineering current density is 795A/mm2. In case of a quench the current density in the copper stabilizer is 1400 A/mm2.
- A network of resistors and diodes was used to protect the magnet. Magnet had survived three training quenches.

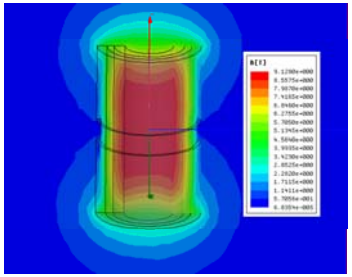
Design and Results

Design

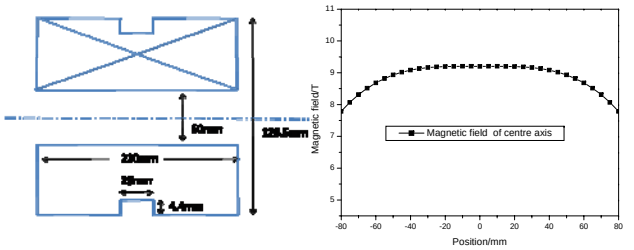


Magnet design			
Center Field /T		9	
Operating Current /A		100	
Operating Current /H		10.7	
Stand		NbTi	
Cu/non-Cu		1.3	
Coil	1	2	3
Stand diameter/mm	0.80X1.09	0.65	0.44
Filaments	565	630	54
Inner diameter /mm	61.0	88.2	106.4
Outer diameter /mm	88.2	106.4	131.0
Height /mm	220	220	220
Turns	3281	4396	10695

Magnetic field distribution



Homogeneity

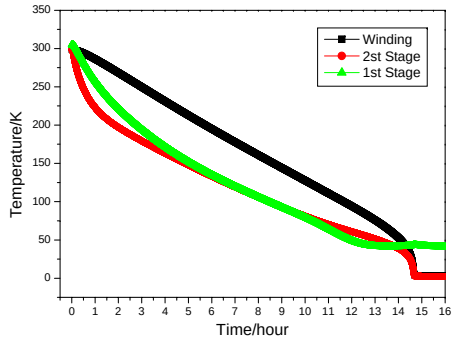


Central field homogeneity better than +/- 0.002% over 15mm length region.

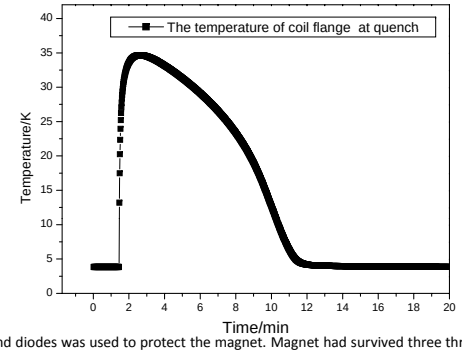
Winding

The magnet were wet-wound with epoxy Stycast 2850

Cool down



Quench protection



A network of resistors and diodes was used to protect the magnet. Magnet had survived three three training quenches

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