High Magnetic Fields from Bulk Superconductors

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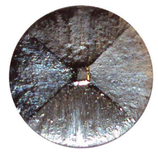
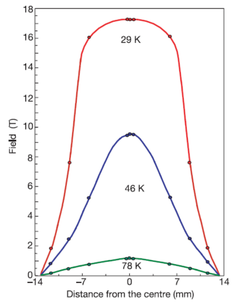


***Abstract*—**Unlike conventional permanent magnets bulk superconductors have no $(BH)_{max}$ limit. In this poster we discuss thee magnitude of fields that can be achieved in the cryocooler accesible 40-60K and 20 K regions using Bulk Superconductors.

Background

In 2003 Tomita et al. showed it was possible to achieve a trapped field of over 17T in a YBCO bulk superconductor. In this work we have aimed to examine if such performance is possible with GdBCO bulks, which should in principle exhibit higher performance



Tomita et al, Nature 421, 517-520(30 January 2003)

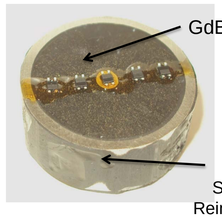
A static magnetic field which is at least equal to the desired charged field is required to magnetise the bulks (unless pulse charging is used). However cryocoolers could be used to move charged bulks to where the field is required thus allowing large semi-portable fields.

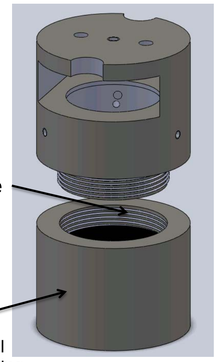
7 T large bore cryomagnet (Cambridge)

1.5T low inductance electromagnet (Cambridge)

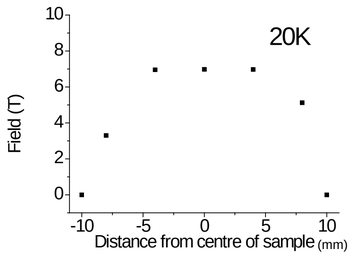
18/20T superconducting magnet (Tallahassee)

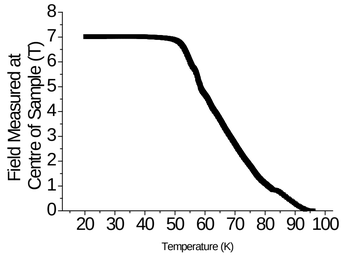
Results



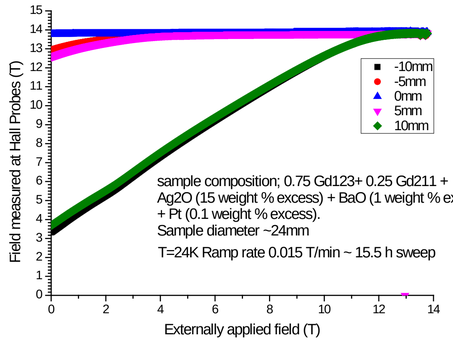


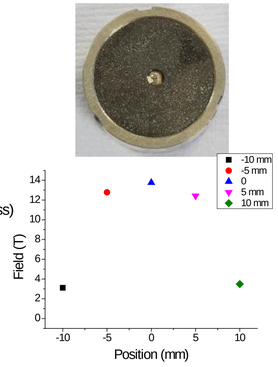
Two bulk samples mounted in stainless steel rings with thermally conductive epoxy resin sandwich hall probes between the two top surfaces. The gap between the top surfaces is <1mm.
In addition to 10 or 15% Ag in the bulk we add a silver heat sink core through the centre of the sample axially to allow for maximum heat removal.





In Cambridge we can apply fields up to 7T. However the sample's peak trapped field remains at 7T until it warms up to above 50K. This implies that single stage portable cryocoolers which can reliably reach that temperature would be suitable for creating portable 7T permanent magnet devices at our facility.





In experiments at 20K conducted in collaboration with FSU we have demonstrated a trapped field of ~14T in stainless steel reinforced sample stacks.
Currently at larger fields our samples suffer mechanical failure due to the large (~20 GN/m^3) Lorentz force densities involved. We hope to improve on this in the near future by increasing mechanical strength of the samples.

Acknowledgements

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