Extremely High Flux Pinning Force in Single Grain RE-Ba-Cu-O Bulk Superconductors Containing Nano-scale Pinning Centers

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Introduction

In previous experiments conducted in the NHMFL DC Field facility we had successfully trapped magnetic fields of over 12.4 T in these high performance materials. Our aim during the week of experiments we conducted in 2013 was to reach higher trapped fields and explore the performance of these materials in the range of field and temperature of applications interest to Boeing. From experiments conducted in low fields at the University of Cambridge we know that our superconductors are, theoretically, capable of trapping over 20 T.

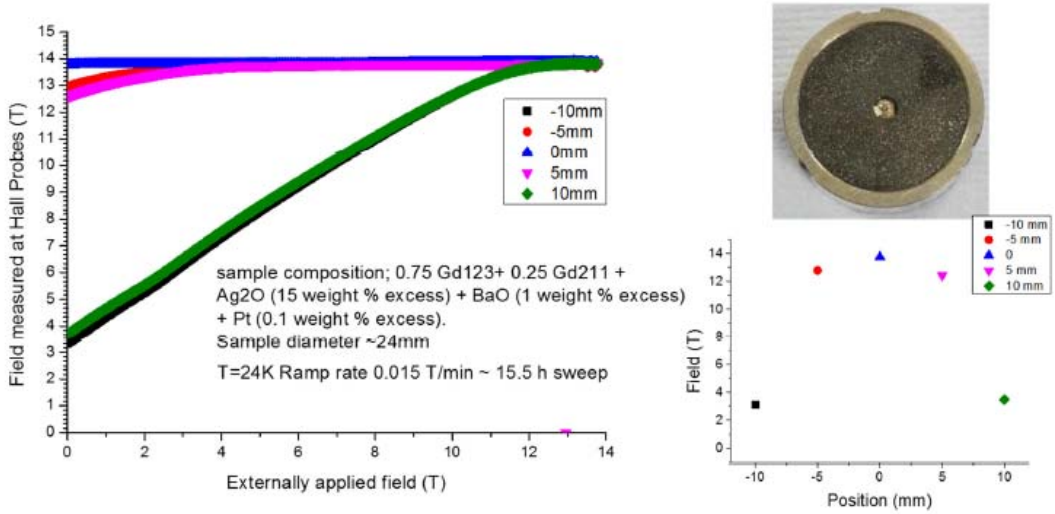

Figure 1. (left) Variation of trapped field with external field. (right upper) sample image. (right lower) trapped field profile after removal of external field.

Experimental

As compared to our 2013 work we had concentrated on improving the pre-stress applied to the samples. This was primarily achieved by heat shrinking stainless steel reinforcement bands onto our samples, the stainless steel used having a relatively large coefficient of thermal expansion to provide further pre-stress on cooling.

Results and Discussion

We were able to successfully trap a 13.7 T field in an Ag- doped GdBaCuO bulk. Figure 1 shows how the magnetic field measured in our sample varied as the external applied field was reduced from 14 T. The field profile observed indicates that the sample was not near to being fully penetrated. Encouragingly this field could be trapped even with relatively fast ramp rates of magnetic field where field was ramped from 14 T to 0 T over 3 hours. In previous experiments very slow ramp rates have been required taking up to 15 hours per experiment. This is greatly encouraging.

Conclusions

Our experimental run at NHMFL in 2013 has allowed us to demonstrate a 14 T trapped field achieved with a three hour field ramp. In our 2014 work we expect to further increase the maximum field that our samples can trap.

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