

ICANS XX,
20th Meeting on Collaboration of Advanced Neutron Sources
March 4 – 9, 2012
Bariloche, Argentina

Design and performance of a cryo-flipper using a YBCO film

S.R. Parnell^{*1}, H. Kaiser¹, F.Li¹, T.Wang¹, D.V. Baxter¹ and R. Pynn^{1,2}

1. Department of Physics and Center for Exploration of Energy and Matter, Indiana

University Bloomington, USA,

2. Spallation Neutron Source, Oak Ridge National Laboratory, Oak Ridge, Tennessee

*stevparn@indiana.edu

Abstract

It is well-known that the Meissner effect in superconducting materials can be used to provide a well-defined non-adiabatic magnetic field transition. This can be utilized to produce a highly efficient neutron spin flipper that is suitable for use on a white beam. However, these devices typically utilize niobium and hence require continuous use of liquid helium in order to maintain the device temperature.

The use of high T_c materials removes the need for cryogenics and has been explored previously [1]. Here we present a design using a 350-nm-thick YBCO film capped with 100 nm of gold on a 78 x 100 x 0.5 mm sapphire substrate (Theva, Germany). We discuss the design and performance of this device. The apparatus is compact (~300 mm in length along the neutron beam), consisting of an oxygen-free high-conductivity copper frame, which holds the YBCO film and is mounted to the cold finger of a closed-cycle He refrigerator. The part of the vacuum chamber, where the YBCO film is located, is ~ 5 cm wide, which allows us to minimize the distance from the film to the magnetic guide fields. This distance is ~30 mm on each side. The details of the guide field design are also discussed. In this design, the maximum neutron beam size that can be used is 45x45 mm² and we can easily switch from a vertical to a horizontal guide field on either side of the YBCO film. Preliminary data of the cryo-flipper in operation at the SESAME beam line at LENS (Low Energy Neutron Source) are shown for neutron wavelengths between 5-15Å.

A discussion of the guide field modeling will be presented with emphasis on producing a uniform field profile at the YBCO film. We also discuss the possibilities for further scaling of the device to larger beam sizes and an even smaller footprint.

Acknowledgements: This project is supported by NSF-grant Number DMR-0956741.

[1] M.R. Fitzsimmons, M. Lütt, H. Kinder, and W. Prusseit, "YBCO films as Meissner screens in the control of polarized neutron beams – Observations and calculations", Nucl. Instr. Meth. Phys. Res. A **411**, 401 (1998).