Thermal properties of bulk $GdBa_2Cu_3O_7$ / Ag superconductors prepared by Single Direction Melt Growth (SDMG) process

D. Szewczyk[1], P. Stachowiak[1], N. Rotheudt[2], T. Hlasek,[3,4], J. Plechacek[3], P. Vanderbemden[2]*

1) Institute for Low Temperature and Structure Research, Polish Academy of Sciences, , 50-422 Wroclaw2, Poland
2) Department of Electrical Engineering and Computer Science, Montefiore Institute B28, University of Liège, Liège B-4000, Belgium
3) CAN SUPERCONDUCTORS, s.r.o., Ringhofferova 66, 251 68 Kamenice, Czech Republic
4) Department of Inorganic Chemistry, University of Chemistry and Technology Prague, Technická 5, Prague 6 166 28, Czech Republic

*Presenting author (Philippe.Vanderbemden@uliege.be)

Abstract: This work deals with bulk $GdBa_2Cu_3O_7$ superconductors prepared by 'single-direction melt growth' (SDMG) [1,2]. This process improves significantly the homogeneity of the trapped field distribution measured close to the top or bottom faces of the sample [3]. Bulk samples processed this way offer therefore great ability as trapped field superconducting magnets [4] or magnetic shields and screens [5]. During pulsed field magnetization or magnetic screening, the sample experiences a time-varying applied field, which causes magnetic losses and a certain self-heating. This may alter the magnetic properties, especially for large size samples. To model and predict the subsequent temperature increase, detailed knowledge of thermal properties is therefore required.

In this work, we characterized the temperature dependence of the specific heat $c_p(T)$ and thermal conductivity $\kappa(T)$ of a single-domain melt-textured bulk GdBCO/Ag ($GdBa_2Cu_3O_7$ + 0.4 mol Gd_2BaCuO_5 + 10% Ag_2O) prepared by SDMG. Remarkably, the thermal conductivity κ measured along the *ab* planes is found to display maximum values (14 W m^{-1} K^{-1}) that are similar to those reported for high quality single crystals, both close to the top and bottom faces. Electrical resistivity vs. temperature is used to determine the electronic contribution of the thermal conductivity, which is found to be a small fraction of the total κ, as well as the temperature dependence of the irreversibility fields for $H||ab$ and $H||c$. We discuss the practical implications of these sets of thermal property data by estimating the resulting self-heating of the sample in typical magnetic screening or trapping experiments.

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