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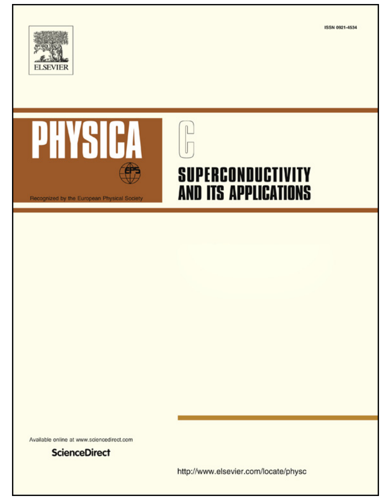

Influence of the inductor shape, and the magnetization processes on a trapped magnetic flux in a superconducting bulk

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ACCEPTED MANUSCRIPT

Influence of the inductor shape, and the magnetization processes on a trapped magnetic flux in a superconducting bulk

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Abstract. In this paper, we study the form of the inductor for producing a magnetic field in a superconductor bulk by using a method of PFM (Pulsed Field Magnetization). We tested two inductors: vortex coil and systeme of three coils, where we found the best results with the systeme of three coils. After that, we presente two processes for trapping a magnetic field in the bulk: direct magnetization and successive magnetization where we found similar results.

1. Introduction

High-temperature superconductors are a new kind of superconductors which are promising materials for the permanent magnet applications [1-5]. Single domain bulk melt-processed RE–Ba–Cu–O has a large potential for use in permanent-magnet like engineering applications, such as magnetic bearings [6, 7], and high power density rotating machines [8-12] because it can trap a high value of magnetic fields [13, 14]. This kind of superconductor bulk can also shield the magnetic field and concentrate the flux to obtain a large density of magnetic field in some applications [15].
Until now, the maximum value of remnant magnetic induction in a permanent magnet is about 1.5 Tesla for NdFeB. But by using the principle of trapping the magnetic field by eddy currents in a High critical Temperature Superconductor (HTS), it is possible to obtain 4 T on the surface of a superconducting bulk at 77 K (liquid nitrogen) and 17 T at 29 K [13].
In general, there is an interest to increase the value of the induction. For example, an application that aims to transfer an effort, increase the value of the induction to increase the value of the magnetic energy in the gap and thus the electromagnetic torque. Our aim is to optimize the magnetization of the superconducting bulk and its processes.
There are several methods of magnetization but we chose the most convenient method to implement in situ, it is PFM "Pulsed Field Magnetization" method. The general principle of this method is to discharge a capacitor in a coil which we call the inductor. This discharge will generate a magnetic field pulse which will induce currents and trapping a magnetic field in the superconductor bulk. This value of trapped magnetic field in the bulk depends on [16- 18]: The critical current density Jc in the bulk, the size of the bulk, and the form of the magnetic field pulse applied on the bulk.
In the literature, the PFM method was carried out by using only one coil, a long cylinder, around the superconducting bulk [19, 20]. Some authors magnetize the bulk by using two coils one above it and the second below it [21, 22, 23]. In this paper, we study a small vortex coil above the bulk which is useful for the application where we don't have a large space to do the magnetization and only one magnetized surface of the bulk is needed. We study also a system of three coils that is useful for the electrical applications where we have enough space (e.g. magnetic coupling, and axial motors applications) and the need for a large value of trapped magnetic field on the two surfaces of the bulk. For both systems, the vortex coil and the two coils, above and below the bulk, in the system of three coils can be removed after the magnetization.
First, we present the experimental devices which we used for doing the magnetization and obtained the profile of magnetic field after the magnetization. We show also the operating mode to obtain the

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