Among the superconducting bulk applications, in the past few years the fabrication of magnetic shields and permanent magnets has generated remarkable interest [1, 2]. In this framework, MgB_{2} bulks are a promising solution due to their more homogeneous J_{c} distribution compared to (RE)BCO bulks. This is provided by the fabrication technique which allows manufacturing products as large and shaped as required by the specific applications. MgB_{2} is a light weight material and this can provide key advantages for portable and space applications.

Here we report the results obtained for an MgB_{2} tube produced via an innovative technique: a machinable MgB_{2}-hBN cylinder is produced by Spark Plasma Sintering and it is axially drilled [3]. The length of the tube is 17.5 mm, the outer and inner radius are 10 and 7 mm, respectively. The transition temperature is higher than 38.3 K. Critical current densities over $2 \times 10^{6}$ A/m² were measured at $T = 30$ K and $\mu_{0}H_{app} = 0.5$ T.

The shielding properties of the tube were determined as a function of temperature and applied magnetic field both in axial and in transverse field configuration, using a cryogenic Hall probe array [4]. Although the aspect ratio of length/outer radius is only 1.75, which makes the magnetic flux penetration from the tube edge not negligible, shielding factor values higher than 175 and 55 were achieved in the center of the tube at $T = 20$ K, in the presence of external fields $\mu_{0}H_{app} = 0.1$ and 1 T, respectively.

The fabrication technique

Commercial powders of MgB_{2} and hexagonal BN were mixed. Spark plasma sintering (SPS) was applied on the powder mixture to produce a bulk cylinder with the average relative density of 91%, height of 18.7 mm and radius of 20 mm. SPS temperature was 1150°C for a dwell time of 8 min. The maximum pressure applied on the sample during sintering was 95 MPa.

The as-prepared specimen is machinable [3]. An axial hole was drilled using drills with different radii. The inner radius of the final product of 7 mm was obtained with a lathe machine. The final height of the tube was 17.5 mm.

Irreversibility temperature and critical current density

Temperature behavior of the field trapped in the center of the tube after the application of the external field $\mu_{0}H_{app} = 1.2$ T (17 to the tube’s axis) at $T = 30$ K.

- Irreversibility temperature, $T_{irr} = 38.3$ K

Critical current densities evaluated from the magnetic induction values, measured by the Hall probes along the tube axis in the axial field configuration, as [5]:

$$j_{c} = \frac{\Delta B}{\Delta \mu_{0}H_{app} r_{out} r_{in} z}$$

where $\Delta B$ is the difference between the induction field measured while increasing and decreasing the external field and

$$\Delta \mu_{0}H_{app} = \mu_{0}H_{app} - \mu_{0}H_{app}$$

being $z$ the axial coordinate (0 ≤ z ≤ tube center)

Since we did not take into account the $J_{c}$ dependence on magnetic field, the real $j_{c}$ values could be higher.

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