Superconducting cryo-magnets processed by Spark Plasma Sintering and Texturing

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In this paper, three main superconducting compounds have been studied:

- Dense oxide $YBa_2Cu_3O_7$ was prepared by Spark Plasma Sintering (SPS) in air using tungsten carbide mould under high pressure. The superconducting properties were measured and discussed.
- The SPS was modified with the aim of obtaining textured lamellar compounds with the $Bi_2Ca_2Sr_2CuO_8$ superconductor ceramics. The new process is referred to as "Spark Plasma Texturing" (SPT). During SPT, the bulk material can freely deform itself. As a result, inter-grain preferential crystallographic orientation is favoured.
- The last study was focused on preparation by SPS of magnesium diboride (MgB_2) cryo-magnets. The role of the starting powder on the superconducting properties of MgB_2 has been investigated. Three sets of bulk MgB_2 material were processed from: (i) commercial available powder, (ii) a mixture of Mg metal and amorphous B using a single-step solid-state reaction process and (iii) a mixture of amorphous boron coated with carbon and Mg metal. The samples were prepared by varying different SPS processing conditions such as temperature, dwell time, applied pressure and atmosphere. The structural, microstructures of the samples were investigated by SEM and TEM and correlated to their superconducting properties. The best sample was prepared at 850°C. At 20 K its critical current density was J_c = 500 kA/cm^2. Herein, we demonstrate that MgB_2 makes an excellent cryo-magnet, maintaining 3,9 T at 20 K at the surface of a 20 mm diameter disk.

Keywords

SPS in air, Spark Plasma Texturing (SPT), superconducting cryo-magnets