Contribution ID: **158** Contribution code: **THU-PO3-612-03** Type: **Poster**

Development of CaKFe4As4 bulks by spark plasma sintering method

Thursday, 18 November 2021 10:00 (20 minutes)

Iron-based superconductors (IBSs) are regarded as promiscing candidate for high magnetic field applications because of its relatively high superconducting transition temperature (Tc), and nearly isotropic upper critical field (Hc2) ˜100 T. Amoung various IBSs, AEAFe4As4 (AE = Ca,Sr,Eu, A = K, Rb, Cs, 1144)[1] superconductors are one of the most recently developed IBSs with several unique features. The Tc, Hc2 and ⊠ of 1144-type compounds are comparable to those of (Ba,K)Fe2As2, which is regarded as one of the best compound for high field applications. The CaK1144 have also unique features such as less compositional fluctuations due to large diffrence of ionic radii of AE and A, and existence of intrinsic defect structures found by STEM observations[2]. These features of the compound could be promising up to intermediate temperatures that are accessible with cryo-coolers. On the other hand, several trials of making CaK1144 as the wires and tapes were already attempted while the critical current density (Jc) performance is not so high due to reaction of CaK1144 with Ag sheath.
Recently, we have succeeded in synthesizing high density CaKFe4As4 bulks by the spark plasma sintering (SPS) method[3]. SPS synthesis allows complete dentification in a very short time, thus avoiding phase decomposition of CaK1144 phase. The relative density of the samples exceeds 95 % of theoretical CaK1144 density. The magnetic Jc of the SPS bulk sample reached 18 kA cm-2 at 4.2 K under 5 T. In this presentation, I will summarize the current situations and recent progress of bulk fabrication of CaK1144 superconductors.

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Session Classification: THU-PO3-612 Bulk Magnets