

## WB8-1-INV

### Development of RE123 and MgB<sub>2</sub> Superconducting Bulk Magnets

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Since the discovery of high temperature superconductors in 1986, superconducting materials come in a variety of forms, not only in wire forms but also in bulk forms [1]. Especially, high temperature superconducting bulk magnets, REBa<sub>2</sub>Cu<sub>3</sub>O<sub>y</sub> (RE123) and MgB<sub>2</sub>, generate strong magnetic field in compact size [2-4], since superconducting bulks have high critical current density under up to high magnetic fields. Once bulks are magnetized, magnetic field by the superconducting current is maintained because of strong pinning and bulks work as strong permanent magnets under the cooling condition. In other word, superconducting bulks are regarded as bulk-shape coils which consist of superconducting wires connected with perfect superconducting joints.

In this presentation, conditions and outlook of high temperature superconducting bulks, RE123 and MgB<sub>2</sub> bulks, are discussed by comparison. Specifically, RE123 and MgB<sub>2</sub> bulk magnets were fabricated and, local and global magnetic properties of these bulks were evaluated to investigate the possibility that superconducting bulks have the potential as a powerful magnet [5].

Furthermore, homogeneity of trapped magnetic field in radial and circumferential directions which is very important for equipment design was also evaluated.

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#### References

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Keywords: superconducting bulk, RE123, MgB<sub>2</sub>, trapped magnetic field

## WB8-2-INV

### Record critical current density in sintered MgB<sub>2</sub> bulks

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To utilize any material in daily-life applications requires a low cost production together with high performance. This applies also for bulk superconducting magnets. In this invited presentation, we will introduce the production route of MgB<sub>2</sub> bulks by a simple sintering solid state reaction technique, which is appropriate for batch production. We prepared several sets of MgB<sub>2</sub> bulks from commercial high-purity powders of Mg metal and carbon-coated amorphous B using a single-step, solid-state reaction process. Some of the samples were rapidly quenched from the sintering temperature of 800 °C down to liquid nitrogen temperature at different stages of the sintering duration (1-5 h). To improve the flux pinning and the mechanical performance of the material, the bulks were produced from Mg-rich MgB<sub>2</sub> material with addition of 1.5 wt.-% carbon-coated, amorphous B powder combined with 4 wt.-% of silver. All samples were characterized by x-ray diffraction and scanning electron microscopy. The superconducting performance,  $T_c$ , and the critical current,  $J_c$ , at 20 K were accessed by means of SQUID magnetometry. The  $J_c$  values in Mg-rich MgB<sub>2</sub> material with 4 wt.-% of Ag were higher than in silver-free MgB<sub>2</sub> bulks. The sample with 4 wt.-% Ag combined with 1.5 wt.-% of carbon-coated B exhibited the highest  $J_c$  of  $5.2 \times 10^5$  A/cm<sup>2</sup> at 20 K and self-field. The MgB<sub>2</sub> sample sintered for 3 h and quenched to LN<sub>2</sub> showed superior  $J_c$  values of  $5 \times 10^5$  A/cm<sup>2</sup> and a sharp superconducting transition with  $T_c$  (onset) at 38.1 K. This  $J_c$  value is twice as high as that of the pure sample, the best value reported so far. Our results demonstrate a strong correlation between the microstructure achieved and the resulting pinning performance.

Keywords: MgB<sub>2</sub>, x-ray diffraction , SEM and AFM, Critical Current Density