

Magnetic properties of MnBi magnets fabricated by spark plasma sintering process

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Powders of $Mn_{1+x}Bi$ intermetallic compound with nominal compositions as $x = 0, 0.08$ and 0.14 , were obtained by mechanical alloying (MA) using a planetary ball mill. To avoid the difficulties arising from difference of ductilities of Mn and Bi and the low melting point of Bi, MA were done in three steps including a heat treatment between steps. The XRD results showed the powders to be consisted of MnBi (LTP) and Bi phases. Particle sizes ranged down to below the estimated single domain size of $0.5 \mu m$ [1] as shown in Fig. 1. Powders were fabricated into tablets of 10mm dia. and 3 mm thick by the spark plasma sintering (SPS) process at $230^\circ C$ and 30 MPa and subsequently heat treated at $250^\circ C$ for 7 days. Magnetic measurements revealed two distinctive features ; high remanence ratios $M_r/M_s > 0.75$ in spite of isotropic process and comparatively high coercive field $H_c > 5kOe$ in spite of long period of heat treatment (Fig. 2). Possible interpretations are suggested in the report.

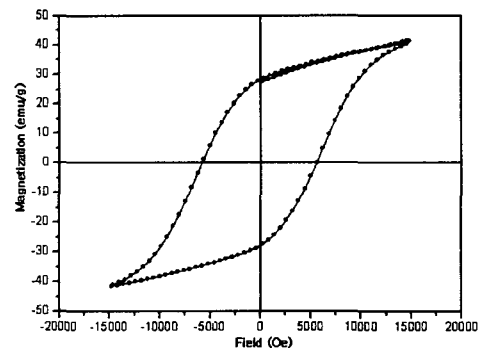
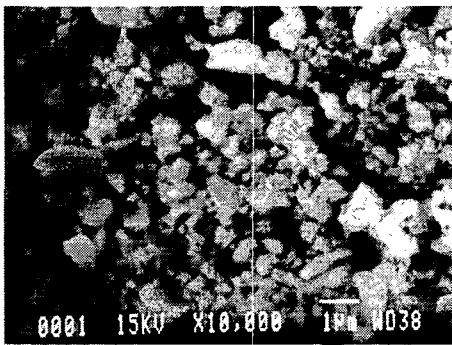


Fig. 1. SEM micrograph of mechanical alloyed MnBi.

Fig. 2. M-H curve of SPSed MnBi magnet.

References

- [1] J. B. Yang, K. Kamaraju, W. B. Yelon and W. J. James, Appl. phys. Let. **79**, 1846 (2001).