

## Magnetic separation and enrichment of MnBi by solidification in high magnetic field

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Magnetic field effects on solidification in a high magnetic field has been reported in many studies, for example, segregation in AlSi hypereutectic alloy and orientation of  $\text{YBa}_2\text{Cu}_3\text{O}_7$ . In this study, we focused on MnBi, which has a relatively low melting point among the ferromagnetic binary alloys. A sample which has a composition having the same Curie temperature  $T_C$  and melting point  $T_m$  was solidified in a magnetic field to enrich and separate MnBi components.

The  $\text{Mn}_{10}\text{Bi}_{90}$  alloy prepared by arc melting method from 4N-Mn and 5N-Bi was vacuum sealed in a glass tube with a diameter of 8 mm. The alloy was heated up to 632 K for 0.5 h and then vertical magnetic field of up to 5 T was applied. The sample was cooled to 545 K of melting temperature of pure Bi with cooling rate of 0.5 K/min. The solidified sample was estimated by XRD and the magnetic properties were measured. Longitudinal sections of sample were observed by SEM and XPS.

Large MnBi grains were observed near and outside the sample center for the sample prepared in 3 T as shown in Fig. 1a. The large grains were aligned along 1-7 O'clock direction of the magnetic field of 5 T as shown in Fig. 1b, and small grains of about 150  $\mu\text{m}$  were arranged in a rod shape. Spikes were observed on the surface of the sample prepared in 3T as shown in Fig. 2, suggesting the appearance of ferromagnetism in liquid state. The same spikes have been reported only in supercooled Co [1], however, this is the first observation in binary alloys.

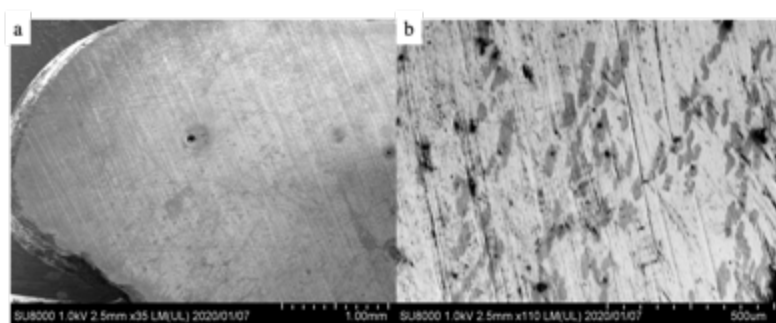


Fig. 1 The longitudinal sections of samples a: 3 T, b: 5 T.

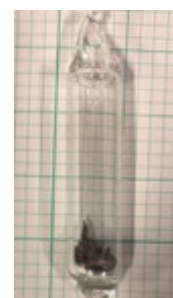


Fig. 2 Spiked sample.

### Reference

[1] Jun Wang, *et al.*, APPLIED PHYSICS LETTERS **105**, 144101(2014).