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Magnetic Phase Transition for Supercooled Liquid of Bi-Mn Ⅱ

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Ferromagnetism of ferromagnetic metals change to paramagnetism at Curie temperature T_C with increasing temperature and a metal melts at the melting temperature T_m, which is much higher than T_C. Thus the metal in the liquid state does not exhibit ferromagnetism. On the other hand, researches about the supercooled state of the metal have been promoted in recent years. Huge clusters formed in the supercooled liquid is considered to reflect the different physical properties of the liquid as a precursor of the solid phase. In other words, through the supercooled metals showing ferromagnetism in the solid state at the vicinity of T_C, exchange interaction of middle-range may occur. It is expected to permit the observation of magnetic phase transition in the supercooled liquid state.

In this study, we have carried out the fabrication and study of the physical properties of Gd-Hg, Co-Sn and Bi-Mn alloys in order to realize the magnetic phase transition of supercooled liquid metal. Bi-Mn alloy with Mn 7 at.%, 10 at.%, 20 at.% and 50 at.% were prepared by arc melting in this report. The heating and cooling devices and the magnetic balance were incorporated with the superconducting magnet to observe the phase transition of the supercooled liquid as shown in Fig.1. We subjected to heating and cooling experiments applied a magnetic field with those alloys. Also the variations in the sample were observed by magnetic measurement using a magnetic balance before and after the experiments.

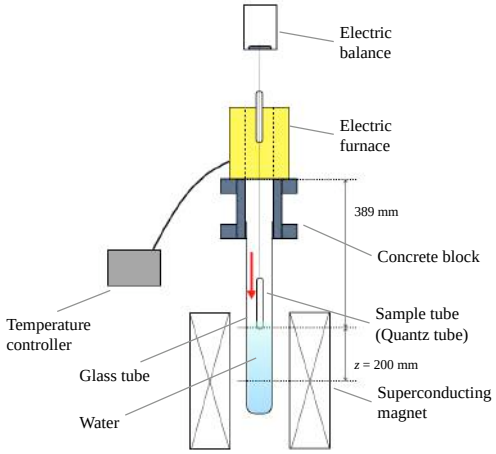

Fig.1. Schematic of the cooling and heating device applied a magnetic field.

Expression of paramagnetic or superparamagnetic (eg. spike phenomenon) is expected as a magnetic in the supercooled liquid state of the alloy. Although the magnetic phase transition in the liquid state is not sure at the moment, some anomaly shapes were observed with the Mn 10 at.% alloy in the sample surface after cooling as shown in Fig. 2. We continue to conduct experiments to investigate the confirmation of the new magnetic behavior.

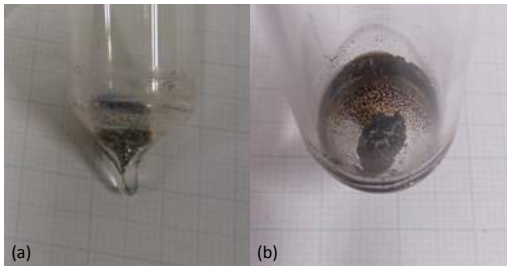

Fig.2. Encapsulated Mn 10 at.% sample (a) encapsulating, (b) after heating.

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