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微小重力下における Fe-Cu 合金の相分離挙動

Phase Separation Phenomena of Liquid Fe-Cu Alloys under the microgravity condition

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1. Introduction

Fe-Cu alloy is one of the popular peritectic alloys, which has a flat liquidus line around intermediate concentration range. It is known that when this alloy around intermediate concentration is quenched from liquid state, a macroscopic liquid phase separation occurs below the liquidus line. Recently, C. P. Wang et al. found that a curious phase separation in atomized Fe-Cu spherical alloys which was formed co-axial multi sphere. Nagayama also make Fe-Cu powders by using atomization with the use of a short drop tube, the same shape of spherical sample was observed. This phase separation attracts interests, however, the mechanism cannot be revealed because the measurement of the temperature measurement of small particle is quite difficult. Recently, we applied the gas-jet levitation method for the observation of this phase separation. As you know, the sample size of gas-jet levitation is around 2 mm which is sufficiently large for the temperature measurement by pyrometers. Then we proposed to the observation of the phase separations under microgravity condition due to the electrostatic levitation furnace, ELF, which is installed on the ISS. Microgravity experiments were performed in last February and March and the cooling curves were obtained. In this report, we show the quick review of our microgravity experiments and discuss the feature of cooling curve.

2. Experiments and Results

2.1. Micrigravity Experiments

For microgravity experiments with the use of ELF, spherical Fe-Cu alloys whose diameter were around 2mm were prepared via the gas-jet levitator coupled with laser diodes. Concentrations of samples were $Fe_{30}Cu_{70}$, $Fe_{40}Cu_{60}$, $Fe_{50}Cu_{50}$, $Fe_{60}Cu_{40}$, $Fe_{70}Cu_{30}$ in atomic percent, those were covered the intermediate concentration range of Fe-Cu alloys. Samples were installed in the sample holder of ELF and launched to the ISS. Samples were processed February 10th, February 17th and March 10th. The sample was levitated in the chamber of ELF and heated by lasers. At the first experiment, the sample position was quite stable at the solid phase, however, it become unstable when the sample was melted. The heating process was adjusted our samples, we could melt and solidify of sample successfully. The samples were retrieved last June, the observation of sample was in progress. The detail of our experiments will be described by Takekawa in poster session.

2.2. Results and discussion

Figure 1 shows the typical cooling curve around the solidification temperature under microgravity condition. A photo image of camera installed in the pyrometer was superimposed on the figure. Many of exothermic signal were observed. We suspect that the first plateau was the signal of the solidification of Fe rich phase,

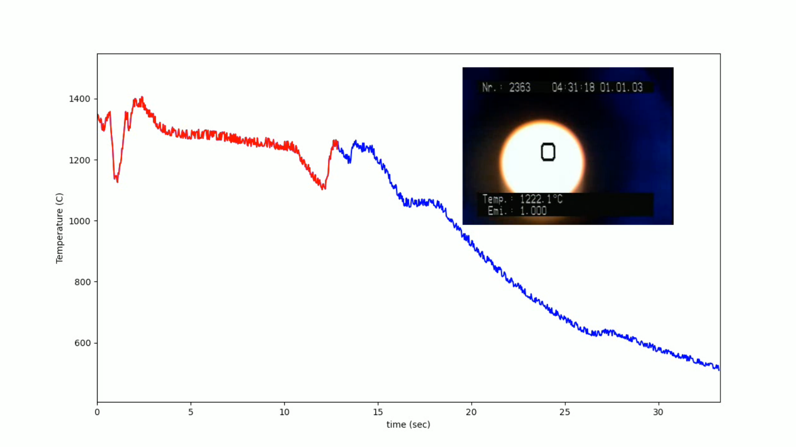

Figure 1. Typical cooling curve of $Fe_{40}Cu_{60}$ alloy at solidification.

which can be seen the time from 0.5 sec to 10 sec in figure 1. The second plateau which can be seen the time from 17 sec to 18 sec can be regarded as the signal of the solidification of Cu rich phase. Exothermic signals at the time around 14 sec might be derived from solidification of small droplets or shells in the sample. The analysis of inside the sample is in progress. The relation between features of alloy structure and these signals will be revealed, which will be described by Takekawa in the poster session.

References

1) C. P. Wang, X. J. Liu, I. Ohnuma, R. Kainuma, K. Ishida, Science 297, 990(2002).
2) Y. Fujiwara, T.Masaki, Proceedings of JASMAC 33 (2021).
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