§23. Investigation of the Phase Transition in V_3Ga PIT Wires Using High Ga Content Cu-Ga Compounds

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V_3Ga compound superconducting wire will be desirable as a candidate material to realize "low activation and high magnetic field superconducting magnet" for an advanced fusion reactor. Recently, we succeeded in developing new V_3Ga mono-cored and multifilametary wires, fabricated via the Powder In-Tube (PIT) process using the high Ga content compounds including above 50at%Ga composition with the aim of the J_c enhancement by the increase of V_3Ga volume fraction [1-2].

For the further J_c improvement, we have investigated the phase transition of V_3Ga phase via the high Ga content Cu-Ga compound/V matrix diffusion composite. In order to study about V_3Ga phase transition during diffusion reaction between high Ga content Cu-Ga compound and metal V, we constructed the in-situ phase transition observation system using the High-Temperature X-ray diffraction (HT-XRD).

The photographs of the sample holder and set-up of the HT-XRD system are shown in fig. 1. The samples holder was made from pure metal V plate having 8 mm of width, 90 mm of length and 2 mm of thickness. Sample holder had three pockets to pack the high Ga content Cu-Ga compound. The thermo couple was also attached by spot welding, and its signal was transmitted into the sample temperature controller of HT-XRD system. The sample holder was set up the goniometer having the two electrodes at both ends shown in fig.1 (b). The sample was heated by the electrical resistance, and the sample temperature was controlled by the output of transport current. The sample was heated in vaccum using turbo molecular pumping. We confirmed that the sample temperature in this system was able to elevate from room temperature to 1200 ℃.

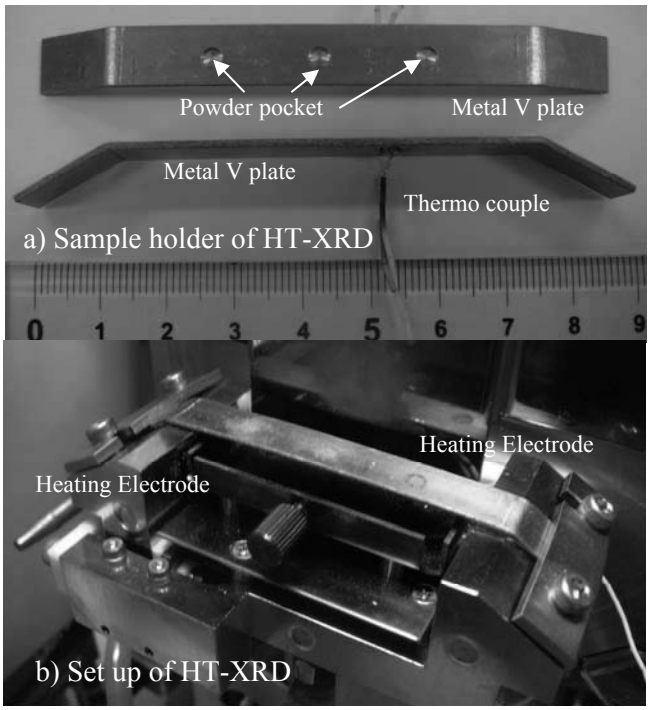

Fig.1 The photographs of sample holder of HT-XRD made by pure metal V and set up of HT-XRD system.

Fig.2 shows that typical XRD patterns of Cu-64at%Ga/V sample according to the sample temperature. It was clear that the Cu-64at%Ga compound mainly consisted of the $CuGa_2$ compound. Increasing of sample temperature at 400℃, the diffraction peak of $CuGa_2$ was decreased. It suggested that decomposition of $CuGa_2$ and release of liquid Ga were started because of the melting point of $CuGa_2$ compound was around 250℃. After that, V_6Ga_5 and V_3Ga phases were appeared above 600℃. The released liquid Ga component would be reacted with metal V plate passively, and V_3Ga phase was formed via the V_6Ga_5 phase. We succeeded to construct the in-situ phase transition observation system using HT-XRD.

In the future, we tried to observe the other compound powders, and optimum heat treatment condition on the high Ga content compound diffusion process will be investigated.

[1] Y. Hishinuma, et.al, SUST, 20, (2007), pp.569-573.
[2] Y. Hishinuma, et.al, J. Phys.:Conf. Ser., 97, 012167

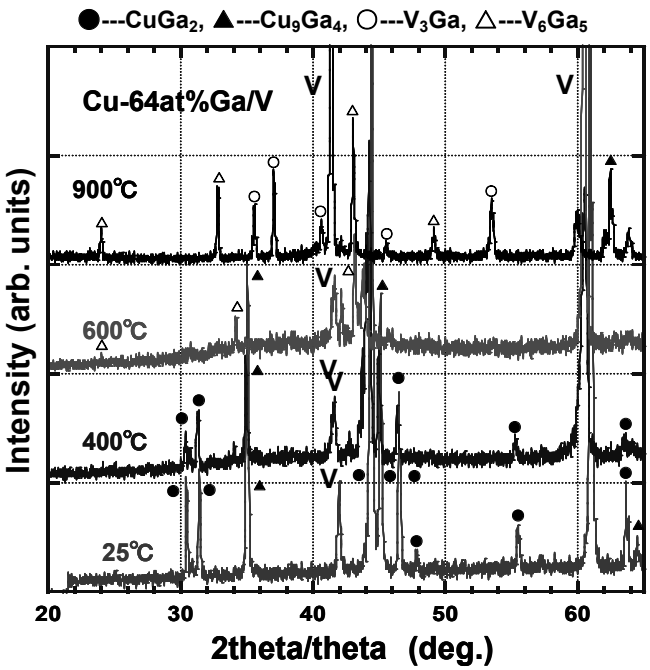

Fig. 2 Typical XRD patterns of Cu-64at%Ga/V sample according to the sample temperature