§17. Microstructure of V_3Ga Superconducting Wires Provided Ga from Ti-Ga Compound

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The drastic critical current density (J_C) improvement by increasing of Sn content in the Cu-Sn matrix on Nb_3Sn was reported. Hishinuma et. al. thought that the high Ga content in the Cu-Ga compound material was an effective method in order to improve J_C of the V_3Ga compound wire, just like for the high Sn content processed Nb_3Sn wires. They tried to develop the new route wire fabrication of V_3Ga compound wire using high Ga content Cu-Ga compound through the PIT processed precursors in order to improve cold workability and volume fraction of synthesized A15 phase, and investigated its microstructure and superconducting properties [1, 2]. It was confirmed that the thicker V_3Ga layer formed along the interface of Cu-Ga powder core and V matrix compared with previous diffusion processed samples in the case of the multifilamentary wires. Upper critical field (H_{C2}) of the samples using high Ga content Cu-Ga compounds was increased with increasing of Ga content into Cu-Ga compounds. And it showed about 23.0 T which value was 2.0 T higher than bronze processed samples when was used Cu-50at%Ga compound powder. But there was no report about the microstructure of high Ga content Cu-Ga/V composite superconducting wire. In this work, we investigated microstructures of V_3Ga phase and interface of Cu-Ga/V_3Ga and V_3Ga/V. In this study, $TiGa_3$ compounds has been used as the source of Ga for the formation of V_3Ga superconducting wires fubricated by PIT method, and its microstructure and crystallographic orientation relationships have been investigated using SEM and TEM .

Fig. 1 shows SEM image of the cross-section of the of $TiGa_3$/V wire. There 3 regions are visible, and those are TiGa core, reacted layer and V matrix. The reacted layer was recognized more 2 regions which are light gray and dark gray. These regions were analyzed by SEM-EDS and each chemical composition was estimated as V:Ga=6:5 and 3:1. This means that the light gray region which is close to TiGa core is V_6Ga_5, and the dark gray region which is close to the V-matrix is V_3Ga. The cross-sectioned sample at the interface between V-matrix and V_3Ga phase was prepared by the focused ion beam method and its sample was observed by TEM. Fig. 2(a) shows its bright field image. Its interface was wavy and crystal grains in the V_3Ga phase were fine compared with large grains of V-matrix. Fig. 2(b) shows the SAED pattern obtained for this area, and it can be indexed as follows;

$[113]_V // [122]_{V3Ga}$, $(1\bar{1}0)_V // (\bar{2}01)_{V3Ga}$

Our next target is more detailed investigation for this sample to obtain microstructure and crystallographic orientation relationships, and to lead the rule of increasing the volume fraction of V_3Ga phase in the future work.

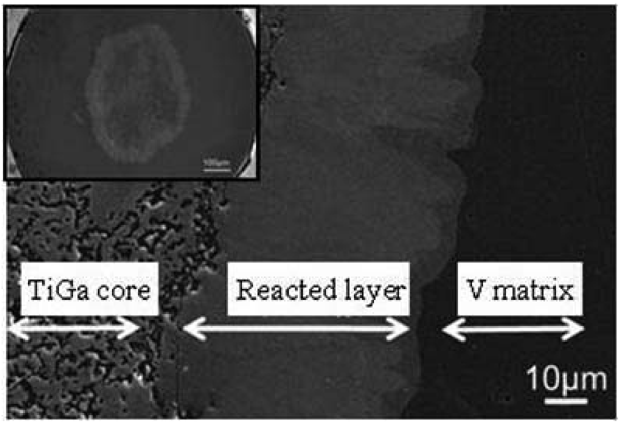

Fig.1 SEM image of cross section of $TiGa_3$/V mono-cored wire

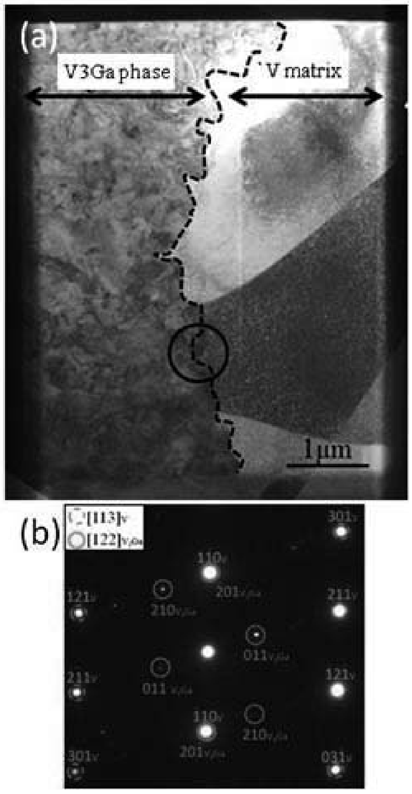

Fig.2 Typical TEM images of $TiGa_3$/V mono-cored wire. (a) cross-sectioned TEM image, (b) SAED pattern

[1] Y. Hishinuma, A. Kikuchi, Y. Iijima, T. Takeuchi, A. Nishimura : J. Japan Inst. Metals, Vol.**71** (2007) 959
[2] Y. Hishinuma, A. Nishimura, A. Kikuchi, Y. Iijima, T. Takeuchi : TML Annual report 2006 (2007) **69**.