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Influence of Ti doping on the Nb3Sn layer formation for various Nb3Sn wire structure

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Ti doping to Nb_3Sn wire is well known as one of the effective ways for improving the superconducting characteristics such as B_{c2} and J_c. Early studies on Ti doping show that Ti doping to Nb_3Sn improve the microstructure, namely, decreasing the average grain size, promoting the Nb_3Sn layer formation, and normal state resistivity ρ_n. Moreover, recent studies on Ti doping to bronze processed Nb_3Sn wire show that the microstructure such as Nb_3Sn grain morphology strongly depends on where Ti is doped, that is, to Cu-Sn matrix or Nb core.For example, thicker Nb_3Sn layer is formed in the case of Ti doping to Cu-Sn matrix, rather than to Nb core. Therefore, Ti doping to the matrix should be better to improve the superconducting characteristics.

In internal-tin processed wire, Ti can be doped to 3 positions, which are Sn cores, Cu matrix, and Nb cores. Based on previous studies on the bronze processed wire structure, Ti doping to the matrix side (Sn cores or Cu matrix) would be appropriate for improving the microstructure also in the internal-tin structure. However, in the case of Ti doping to Sn cores, Sn-Ti compounds are reportedly formed at the subelement boundaries, which prevent uniform Sn and Ti diffusion. The Sn-Ti compound formation would affect to the Nb_3Sn layer formation, however, the detail have still been unclear.

In this study, we investigated the microstructure and superconducting characteristic on the simple diffusion couple specimens with bronze processed and internal-tin processed structure with Ti doping to the various position, to reveal the effect of Ti doping position on the microstructure. In addition, we also examined an additional elemental doping with Ti to Nb_3Sn wire.

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