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Effect of precursor film thickness and heat-treatment temperature on superconducting joint

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GdBa₂Cu₃O_{7-δ} (GdBCO) has high critical current density (J_c) of the order of 106 A/cm² at 77 K in self-field and higher critical temperature (T_c) than that of YBa₂Cu₃O_{7-δ}. Therefore, GdBCO coated conductor (CC) has been expected as a promising wire material. For the wire application, superconducting joint of CC has been required to lengthen them. In our previous work, superconducting joint of GdBCO CC has succeeded via crystallizing two samples of CC with precursor film of GdBCO at face-to-face manner. To obtain high current with low resistance in jointed sample, high crystallinity of GdBCO at joint area and wide joint area play important roles. In this work, we investigated the joint conditions by focusing on heat-treatment temperature and precursor film thickness because these conditions affect crystallinity of GdBCO and joint area. Two GdBCO samples were prepared, one with a precursor film and another without it. The precursor film was prepared with thickness of approximately 50 nm to 200 nm by a pulsed laser deposition method. Then the samples were set face-to-face and crystallized at 720°C to 820°C under mechanical pressure of 40 Pa in an electric furnace to join them. In terms of heat-treatment temperature, X-ray analysis revealed that peak intensity ratio of GdBCO crystallized at 800°C was 1.5 times than that at 720°C. Optical microscope observation showed approximately 1.6 times increase of joint rate at 800°C in comparison to the one at 720°C. When we increase precursor film thickness from 50 nm to 200 nm, joint rate increased from 15.7 % to 25.4 %. These experimental results showed that heat-treatment around 800 °C with thicker precursor film are effective conditions for this process.

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