

WBP2-3

Post-Annealing Effects of MgB₂ Thin Film Prepared on Stainless Steel Tape

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MgB₂ is an intermetallic superconductor with a high critical temperature (T_c) of 39 K, which leads to an operation temperature of approximately 20 K. We recently reported that high J_c of 6.4×10^5 A/cm² at 20 K and 5 T was achieved in the MgB₂ thin film prepared on Si single crystal substrate and then annealed at 550 °C [1]. For the development of practical superconducting wires, MgB₂ films should be deposited on metal tapes. In this study, we prepared MgB₂ thin films on stainless steel (SS304) tape with relatively high mechanical strength.

MgB₂ thin films were prepared on SS304 tapes by an electron beam evaporation technique and about 5 nm-thick Nb layers were deposited on the MgB₂ layers by using a coaxial vacuum arc evaporation gun. The Nb/MgB₂/SS304 specimens were then moved to a sputtering chamber and 1 μm-thick Nb layers were deposited on them for preventing Mg evaporation during the post-annealing process. The post-annealing was conducted at 550 °C for 1 hour under H₂ (3%) + Ar atmosphere to improve the superconducting properties.

The post-annealed Nb/MgB₂/SS304 specimen showed the T_c of 33.5 K and J_c of 1.4×10^5 A/cm² at 20 K and 5 T. Crystallinities, microstructures, and interfacial reactions will be also discussed.

[1] S. Horii et al., APEX 11 (2018) 093102