

In-situ Annealing of MgB₂ Thin Films Prepared by rf Magnetron Co-sputtering

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We have studied the effects of in-situ annealing on the fabrication of superconducting MgB₂ thin films prepared by rf magnetron cosputtering. Films were deposited on Al₂O₃ (1102) substrates at room temperature by using Mg and B targets. To trap remnant O₂ gas in the chamber, we used 20 mtorr Ar sputter-gas balanced with 5 mol % of H₂ gas. To enhance adhesion to the substrate a thin layer of B was deposited prior to the codeposition of Mg and B. After completion of the film deposition, an additional Mg layer was deposited on top to compensate for Mg loss during the subsequent in-situ annealing. We have investigated the effects of two most important annealing parameters that are Mg-to-B composition ratio and annealing temperature. The range of Mg-to-B composition ratio was from 0.42 to 0.85, and that of the annealing temperature was 500 °C ~ 750 °C. Best result was obtained for the composition ratio of about 10 % Mg excess from the stoichiometry and the annealing temperature of 700 °C. Based on these results, we obtained films with T_c = 37 K by further refining the fabrication process.

Keywords : MgB₂ thin film, magnetron sputtering, in-situ annealing