Josephson junctions fabricated by focused ion beam from ex situ grown MgB_2 thin films

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Abstract

We prepared MgB_2 thin films on $SrTiO_3$ (1 0 0) and Al_2O_3 (1 Γ0 2) substrates by e-beam evaporation of MgB_2 pellet. The films were deposited at room temperature and post-annealed at 900 °C in Mg vapour for 5–30 min. Superconducting transition temperatures were observed between 22 and 30 K. Structure and surface morphology of the films were investigated by X-ray diffraction (XRD) and atomic force microscopy (AFM). The films grown on Al_2O_3 substrates are *c*-axis oriented while a film grown on $SrTiO_3$ substrate is aligned with the (1 0 1) direction normal to the substrate planes. The films have grain sizes of about 70 nm. The films were patterned into 4 and 8 μm wide microbridges. The microbridges were observed to carry large critical current densities of approximately 1 MA/cm^2 at 6.7 K. Focused ion beam (FIB) was used on the bridges in order to fabricate Josephson junctions. A cut 50 nm in width was made across the microbridges followed by an in situ platinum (Pt) deposition into the cut made. SNS-like weak-link junctions were formed in the process.

Keywords

- Superconducting;
- MgB_2;
- Thin films;
- Ex situ;
- E-beam evaporation