

Preparation of Bi Based Superconductive Films by Sputtering Technique and Their Application to Magnetic Sensor

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The Bi based superconductive films have been expected to apply to the field of different electronic devices due to their high T_c and high J_c . The preparation of Bi based superconductive films by means of annealing after being sputtered has been investigated and their application to a miniaturized magnetic sensor tested.

It was found that the two-steps annealing of as-sputtered films ; primary annealing at 720-820°C and secondary at 834-850°C was effective for the preparation of the high T_c ($T_c > 100\text{K}$) Bi based films, and the formation of liquid phase in the films predominantly resulted from Ca and Cu components was harmful for high T_c and high J_c . The surface-smoothed film of low Ca and Cu content which was prepared by the two-steps annealing at 780°C and 835°C showed both the high T_c of 106 K and the high J_c of 27,000 A/cm² at 77.3 K and 0 Gs. While, the J_c of the film decreased with increasing of the magnetic field applied, because the grain boundaries composed of PbO, CuO and Bi₂O₃ apparently acted as electrical weak-links in the films. The film of low Bi content showing high T_c and low J_c also was of high magnetic sensitivity even in the extremely weak magnetic field. Then, the optimum magnetic sensor showed the high magnetic sensitivity of 100 mV/Gs below 1 Gs and the high magnetic field resolution of $1.82 \times 10^{-6} \text{ Gs}/\sqrt{\text{Hz}}$ at 100 Hz. Furthermore, it was possible to microminiaturize the magnetic sensor of high sensitivity by a photolithography method. It is probable that this sensor may be suitable for the detection of very weak magnetic field so much.