Proceedings of the Korean Superconductivity Society Meeting 1999
(KSS 99), YongPyung, Kangwondo, Korea, Aug. 18-20, 1999

High-Tc SQUIDs and their applications

Byungdu Oh*

LG Corporate Institute of Technology, Seoul 137-724, Korea

The noise properties of SQUIDs made of high-Tc superconducting materials have been improved remakably. In addition, the diverse applications of SQUIDs are demonstrated in various fields ; biology, semiconductor packaging, NMR and NQR, and preamp, etc. In this seminar, some device issues and current applications in magnetically unshielded environment are presented. To use SQUIDs in magnetically unshielded environment, we should consider how to minimize the noise of them in ambient magnetic field. One approach is to reduce the noise due to the flux motion in the superconducting material in ambient magnetic field. The other is to use them as 1st or 2nd order gradiometer.

To reduce the noise of the directly coupled SQUID magnetometer, we have replaced the solid-film washers with narrow-linewidth structures. We have studied the low-frequency noise properties of directly coupled magnetometers involving dc SQUIDs connected to four different types of pickup loop. Two of the pickup loops have a solid washer design, while the other two comprise structures with narrow (4 um) linewidth. The devices were fabricated from YBCO thin films laser deposited on bicrystal substrates. The noise properties of the magnetometers cooled and maintained in static magnetic fields were measured at 77 K. The pickup loop contributes to the 1/f noise of field-cooled devices solely through vortex motion at tapered outer edges; this noise was eliminated by repatterning the edges to make them sharp. We demonstrate that solid-film washers can be replaced with narrow-linewidth structures without any loss in effetive area.

We have also studied a planar-type second order gradiometer fabricated from single-layer YBCO films. The gradiometer consists of a symmetric flux transformer with an overall length of 80 mm inductively coupled to a directly coupled magnetometer, and has a baseline of 31 mm. The mutual inductance between the flux transformer and the magnetometer is adjusted mechanically to reduce the response to a uniform magnetic field applied perpendicular to the plane of the gradiometer to typically 50 ppm. From an independent measurement, the residual first-order gradient response was determined to be at most 1.4 % relative to the second-order gradient response.

The recent applications of SQUIDs in unshielded environment are to be overviewed briefly.

*This work was done in UC Berkeley, Department of Physics, Prof. J. Clarke's Group, while the author was visiting in 1998. The collaborators are in the following references.

1. H. M. Cho, R. McDermott, B. Oh, K. A. Kouznetsov, J. H. Miller Jr. and J. Clarke, to be published in IEEE Trans. on Supercond., (1999).
2. A. Kittle, K. A. Kouznetsov, R. McDermott, B. Oh, and J. Clarke, Appl. Phys. Lett. 73, 2197 (1998).