DEVELOPMENT OF HIGH T_c SQUID DEVICES

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The use of high T_c superconducting materials as Superconducting Quantum Interference Devices (SQUIDs) has received considerable attention.[1] For example, Zimmerman *et al.*[2] have reported rf–SQUID properties in a break–junction which reached an equivalent flux noise level of $4.5 \times 10^{-4}\ \phi_0/\sqrt{Hz}$ at 77K. Zhang *et al.*[3] have developed a "double–holed" rf–SQUID using 123–YBaCuO material and observed an equivalent noise of $6.0 \times 10^{-4}\ \phi_0/\sqrt{Hz}$ at 77K. The primary concept guiding the construction of the bulk material devices is based upon the present understanding of the inherent weak links existing within the sintered superconducting pellets.[4] The double–hole configuration mimics the low temperature Nb point–contact devices which suppress ambient noise by cancellation via the screening currents in the weak links. One present limitation of the effectiveness of SQUID units operating at 77K is the absence of a suitable superconducting flux transformer.

At the University of Florida, our work has focused on the construction of both dc– and rf–SQUIDs whose weak–links would be microbridges in thin films of 123–YBaCuO deposited on MgO and sapphire substrates. The I–V characteristics of the films are measured between 4K and 100K and in magnetic fields up to 100G. Consistent with the reports from numerous other groups, these properties degrade with age despite standard efforts to protect the films from the room environment. We have investigated several types of "packaging" the films in order to make them more robust. In addition, we have made several microbridges, either by scratching the film or masking during deposition. Our characterization studies have attempted to establish whether the bridges work as a global weak link or as a network of links found in the bulk devices. Finally, we have investigated various means to improve the noise characteristics of the sample coil coupling through the use of 77K superconducting "wire".

1. T. Ryhänen, H. Seppä, R. Ilmoniemi and Jukka Knuutila, Jour. Low Temp. Phys. 76 (1989) 287.
2. J.E. Zimmerman, J.A. Beall, M.W. Cromar and R.H. Ono, Appl. Phys. Lett. 51 (1987) 617.
3. Xiafeng Zhang, Jinwu Qiu, Zhiming Tang and Yongjia Qian, Solid State Comm., to be published.
4. M. Tinkham and C.J. Lobb, Solid State Physics 42 (1988) 91.

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