Development of Small-sized SQUID and dc Feedback Electronics for High-T_c Scanning SQUID Microscope

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The spatial resolution of high-T_c scanning SQUID microscope is limited by the washer size of SQUID and the gap distance between SQUID sensor and the sample. The rectangular sape of SQUID chip limits the control of gap distance between sample and SQUID sensor. In this work, we tried to improve the spatial resolution of scanning SQUID microscope by reducing the size of SQUID sensor fabricated with $YBa_2Cu_3O_7$ thin film. Outer dimensions of the SQUIDs we tested are 10 μm × 10 μm, 12 μm × 12 μm, 12 μm × 16 μm, 24 μm × 28 μm each. To operate them in the flux-locked loop scheme, we used a dc feedback electronics instead of using conventional electronics which involves a modulation scheme. Since the dc feedback scheme does not require modulation current adjustment that poses as a practical difficulty in the SQUID operation of modulation-scheme, the dc feedback operation is rather simpler than the conventional modulation method. The resulting noise features were dominated by the noise of preamp in FLL electronics except that of the largest SQUID. The noise level of SQUIDs is expected below 1×10^{-5} $\Phi_0/Hz^{1/2}$ (at 300 Hz), that is a typical noise level for SQUID made of $YBa_2Cu_3O_7$ thin film. The electrical wiring, data aqcuisition, and the motion-controlling part were also improved, resulting in a lower electrical noise, faster data acquisition rate, and less vibration of the system.

keywords : SQUID, scanning SQUID microscope, flux-locked loop