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Improved Low-Frequency Noise of High-T_c SQUID Magnetometer with Serial Flux Dams

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We fabricated a serial low-noise direct-current superconducting quantum interference device (SQUID) magnetometer on a 10 mm × 10 mm $SrTiO_3$ (100) bicrystal substrate. The magnetometer is directly coupled and the SQUIDs are in serial arrangement and with different junction widths. In order to suppress the vortex motion in the pickup loop, the width of pickup loop across grain boundary was 5 μm to form the flux dam. The noise was measured to investigate the effect of the serial flux dams on the low frequency noise characteristics. These results suggest flux dam can be fabricated using uniform serial junctions connected with pick-up loop. The serial SQUID arrays with flux dam also offer the advantage in reducing the low frequency $1/f$ noise of SQUID.

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I. INTRODUCTION

Superconducting quantum interference device (SQUID) is the most sensitive device to detect a weak magnetic flux change that applies to medical diagnosis, nondestructive testing, biomagnetic analysis [1–3], geological survey and so on. Active research in the development of high-T_c SQUID is being conducted worldwide and its commercialization is expected soon. However, because of their higher operating temperature, HTS SQUIDs have intrinsic noise levels higher than that of LTS SQUIDs. Unfortunately, HTS SQUIDs suffer from excess $1/f$ noise associated with flux motion in the superconductor. Therefore, it is considerably crucial to reduce the low frequency flux noise for HTS SQUIDs [4–6]. A high-T_c magnetometer is usually fabricated on a bicrystal or step-edge substrate. At the same time, in order to create the most sensitivity SQUID, the geometry of magnetometer is designed by pickup loop or washer. In both case, the pickup coil crosses the grain boundary of the bicrystal substrate. In generally, the line width of the pickup coil is very wide. It is expected that the flux quanta is easily trapped in the pickup coil. Thermal activated hopping of these trapped fluxes will cause the low-frequency noise. In this regarded, the pickup coil of the magnetometer mainly causes this excess low-frequency noise. Flux dam are widely used in high-T_c SQUIDs magnetometers to reduce flux trapping in thin films of the magnetometers. This has the effect of damping the circulating current when a moderate change in field is applied to the pickup coil. When the circulating current around the pickup

