

## High- $T_c$ 2nd-order SQUID Gradiometer for Use in Unshielded Environments

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We have fabricated  $\partial^2 B_z / \partial x^2$  type planar gradiometers and studied their properties in operation under various field conditions.  $YBa_2Cu_3O_7$  film was deposited on  $SrTiO_3$  (100) substrate by a pulsed laser deposition (PLD) system and patterned into a device by the photolithography with ion milling technique. The device consists of 3 pickup loops designed symmetrically. Inner dimension and the width of the square side loops are 3.6 mm and 1.2 mm, respectively, and the corresponding dimensions of the center loop are 2.0 mm and 1.13 mm. Baseline of the gradiometer is 5.8 mm. Step-edge junction width is 3.5  $\mu\text{m}$  and the hole size of the SQUID loop is 3  $\mu\text{m} \times 52 \mu\text{m}$ . The SQUID inductance is estimated to be 35 pH. The device was formed on a 20 mm x 10 mm substrate. We have tested behavior of the device in various field conditions. The unshielded gradiometer was stable under extremely hostile conditions on a laboratory bench. Noise level measured on the lab bench without shield was  $2.3 \times 10^{-9} \text{ T/m}^2/\text{Hz}^{1/2}$  at 10 Hz. Details including noise properties with and without a shield and MCG measurements will be discussed.

Keywords:  $YBa_2Cu_3O_7$ , 2nd-order SQUID gradiometer, noise