Determination of Sheet Current Patterns of HTSC Films Fixed in a Magnetic Field by Measurements of Magnetic Field

Gaikovich K.P., Nozdrin Ju.N., Reznik A.N., Zhilin A.V.

Institute for Physics of Microstructures RAS, GSP-105, Nizhny Novgorod, Russia, 603600,
Phone: 8312 327920, Fax: 8312 675553, E-mail: gai@ipm.sci-nnov.ru

A method of remote sensing of HTSC films fixed in a magnetic field based on retrieval of 2-D vector field of the sheet current by measurements of 2-D magnetic field distribution (above their surface) has been worked out. Hall transmitter with the sizes 100 and 50 μm in the *x*-*y* plane and 10 μm in *z*-direction was applied in experiments. The noise level was about 0.1 gauss. In Fig.1 2-D distribution of *z*-component of the magnetic field for the thin (about 0.1 μm) square film with a lateral length of 10 mm, measured at height level of 300 μm, is shown.

Using the Biot-Savart's law, written for surface current density

$$H_z = \frac{1}{c}\iint \frac{\left[\vec{j}\vec{R}\right]}{R^3}dx'dy' = \frac{1}{c}\iint\left(j_x \frac{y-y'}{R^3} - j_y \frac{x-x'}{R^3}\right)dx'dy' \qquad (1)$$

and the condition $div\ \vec{j} = 0 \ \Rightarrow \ \frac{\partial j_x}{\partial x'} = -\frac{\partial j_y}{\partial y'}$, integral equations (of 2-D convolution type) for two components of current have been obtained. These equations have been solved using Tikhonov's method of generalied discrepancy. For *x*-component of sheet current such an equation is expressed as:

$$H_z = \frac{1}{c}\iint j_x(x',y') \frac{Y\left[z^2(X^2+Y^2+2z^2) - X^2(X^2+Y^2)\right]}{(X^2+Y^2+z^2)^{3/2}\left(X^2+z^2\right)^2}dx'dy', \quad X = x-x',\ Y = y-y'. \qquad (2)$$

In Fig.2 the result of sheet current retrieval is presented for the central part of HTSC film.

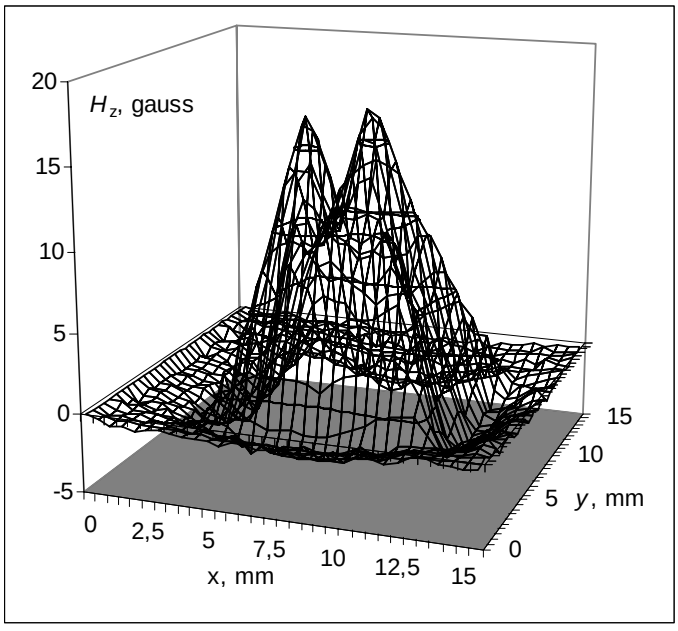

Fig.1

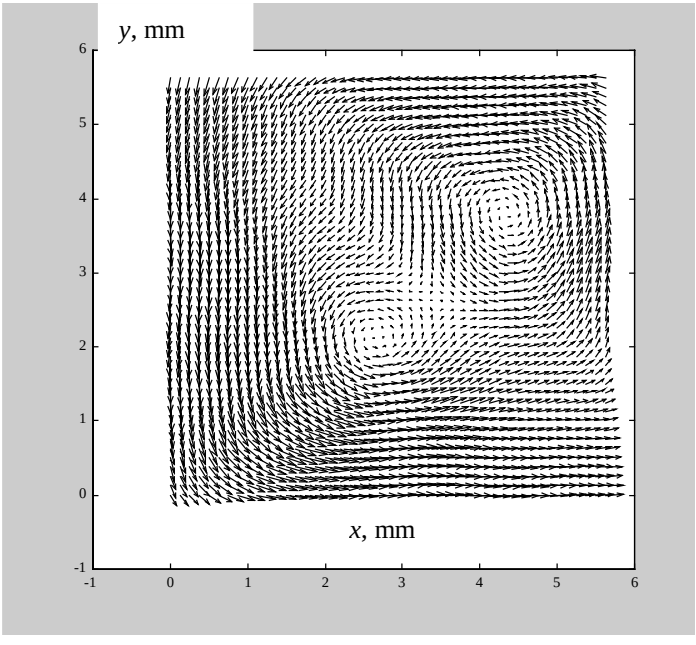

Fig.2

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