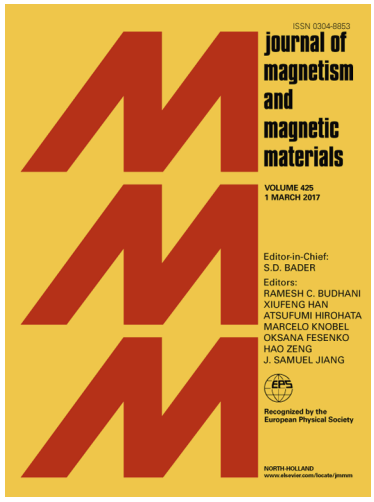

Longitudinal magneto-optical images of stray fields on the surfaces of hard magnetic elements

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PII: S0304-8853(17)31627-X
DOI: https://doi.org/10.1016/j.jmmm.2018.03.063
Reference: MAGMA 63834

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 29 May 2017
Revised Date: 23 March 2018
Accepted Date: 26 March 2018

Please cite this article as: V.E. Ivanov, A.V. Koveshnikov, Longitudinal magneto-optical images of stray fields on the surfaces of hard magnetic elements, *Journal of Magnetism and Magnetic Materials* (2018), doi: https://doi.org/10.1016/j.jmmm.2018.03.063

JMMM

Longitudinal magneto-optical images of stray fields on the surfaces of hard magnetic elements.

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The structure of magneto-optic images of the planar component of stray fields on the faces of prismatic hard magnetic elements is determined experimentally and by means of computer simulation. Magneto-optical images were registered using the longitudinal magneto-optical Kerr effect. FeCo films with in-plane anisotropy were used as indicator films. A qualitative explanation to the structure of magneto-optical images was given on the ground of the symmetry of the plane field, produced by hard magnetic elements.

Keywords: inhomogeneous magnetic field, Kerr effect, magneto-optical images, intensity, singular points.

1.Introduction

Using magnetic metal films with in-plane anisotropy for the visualization of inhomogeneous magnetic fields in the geometry of magneto-optical longitudinal Kerr effect [1] allows for the gathering of information about the distribution of normal (H_z) and planar ($\boldsymbol{H}_p$) components of the stray field [2]. It is possible due to the fact that the magneto-optical images (MOI) in these experiments are an overlap of two patterns responsible for the distribution of the normal and planar components of the inhomogeneous field. MOIs in polar Kerr sensitivity allow for, in the same way that it was done using the Bi-doped YIG film [3], to carry out the mapping of $H_z(x, y)$–component of the field [4]. MOIs in longitudinal Kerr sensitivity detect the singular points of the inhomogeneous vector field, the position of which changes under the influence of the homogeneous external field [2]. The authors proposed to use this phenomenon for the topography of the planar component of the inhomogeneous field.

Modeling of MOIs demonstrated that when the observation plane was distanced from the magnet, they was simplified, reflecting the dipole nature of the magnet, forming one [5] or two singular points [6]. Analysis of the topological structure of this planar field may contribute to the definition of the global structure of the three-dimensional complex field [5]. In our work we analyze the structure of MOIs in longitudinal Kerr sensitivity, reflecting the distribution of the planar component of the stray field on the surfaces of the hard magnetic elements (HME), having the forms of right prisms. Special attention is paid to the MOI in the vicinity of surfaces, perpendicular to the magnetic moments of these elements.

2. Experimental methods and modelling

MOI of inhomogeneous magnetic fields in magnetic metal films (FeCo) were observed applying the longitudinal Kerr effect with the use of s- and p-polarized light. We used the standard MO imaging set-up for the large view magnetic domain observations [7] (Fig. 1). The methods for separating and increasing the quality of MOIs are described in the reviews [1, 7]. An essential point for increasing the quality of MOI is acquiring these images in the state of magnetic saturation of the indicator film (reference image). We cannot achieve this state due to the large field of the magnets. Thus, the separation of the MOI, reflecting the distribution of H_z – and $\boldsymbol{H}_p$–components of the inhomogeneous field was carried out in an abbreviated procedure using MathCAD application package, in the same way that it was done in [4]. The sequence of operations is described in detail in [8].

In order to carry out the quantitative analysis of the MOI, we digitized them in MathCAD application package. Then, using the program, developed in [6], we constructed the graphs of the angular distribu-