Analysis of Electron Holography Fringes for Investigation of Magnetic Properties of FeSiB Thin Foils

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Modern transmission electron microscopes can be used to obtain images of holography fringes carrying information about phase shift of electron wave interacting with a sample. The phase shift consists of contributions introduced by electric and magnetic fields. Several methods were developed for separation of these contributions. In one of them, two electron holograms for "normal" and "inverted" sample orientations are registered and then used to refine inner electric and magnetic fields of a sample. The results of this method for FeSiB sample are shown in Fig. 1(a,b). Electric phase shift contours (see Fig. 1a) are strongly thickness-dependent and tend to be parallel to the edge of the sample and fringes density corresponds to the increase of sample thickness. On the other hand magnetic phase shift contours (see Fig. 1b) are not limited to the sample area, but also, due to tip-shaped sample geometry, they propagate into the vacuum.

Another method for separation of electric and magnetic contributions to phase shift is *in-situ* magnetization reversal experiment where we use an objective lens to apply external magnetic field to a sample. In Fig. 1(c,d), response to the application of external magnetic field is presented. In the absence of external magnetic field (see Fig. 1c) phase shift contours are parallel to the edge and enclosed inside the sample. Interestingly, phase shift contours, after switching on external magnetic field (see Fig. 1d), drastically altered their configuration. It is clearly seen that external magnetic field, perpendicular to the sample surface, rotates the phase shift contours by almost 90 degrees in the surface plane of the sample.

These and other results obtained for FeSiB alloy samples will be presented and discussed.

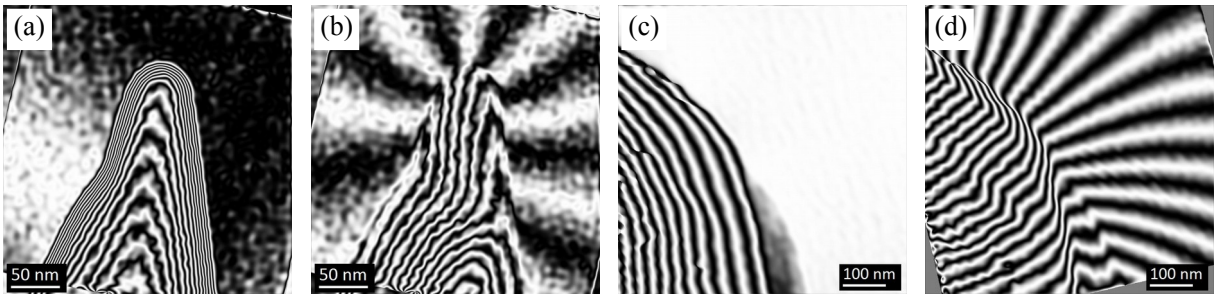

Fig. 1. Electric phase shift contours (a) and magnetic phase shift contours (b) obtained for finger-shaped area of magnetic FeSiB sample. Total phase shift contours in the flat-shaped area of FeSiB sample, in the absence (c) and in the presence (d) of external magnetic field, applied in direction perpendicular to the image plane.

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