ELEMENTS OF MORPHOLOGY OF STRAINED EPITAXIAL GARNET FILMS

A.S. Nedviga, A.G. Nesteruk, V.G. Vishnevskii, H.T. Milyukova, V.N. Berzhansky, A.V. Karavainikov, H.V. Danishevskaya, A.N. Shaposhnikov

V.I. Vernadsky Taurida National University, Simferopol, Ukraine
E-mail: domain@crimea.edu

Magneto-optic high-coercive epitaxial garnet films (EGF) are required in several modern usages; atomic traps technique is an example [1]. As a media for thermo-recording, EGFs have being synthesized with account of considerable mismatch between crystalline constants of film a_f and substrate a_s. It means that epitaxial layers are strained and misfit dislocations networks exist. Because the dislocations have an essential influence on the EGF magnetic properties, ion beam and selecting chemical etching with optical and SEM microscopy were used to investigate changes of dislocations distribution versus mismatch Δa.

The studied films with compositions $(Bi, Lu, Sm, Ca)_3 (Fe, Ga, Al, Sc, Zr)_5O_{12}$ and $(Bi, Sm, Lu, Yb, Ca)_3(Fe, Al)_5O_{12}$ were synthesized on $Gd_3Ga_5O_{12}$ substrates with the (111) orientation ($a_s = 12.383$ Å). The compositions difference was stipulated for Curie points ($T_C < 100$ °C and $T_C > 200$ °C). To obtain coercivity $H_c \sim 100$ Oe, lattice mismatch $\Delta a = +(0.04 \div 0.113)$ Å was used [2]. As grown films thicknesses $h = 4\text{-}7$ μm; before etching the samples were wedge-like polished.

The experiment demonstrates complicated dependence of misfit dislocations density on Δa, distance from film-substrate interface and etching method (Fig. 1).

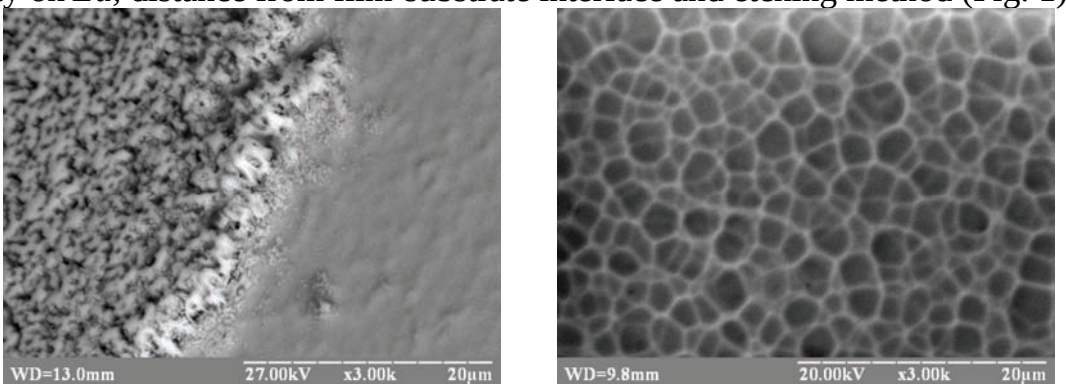

Fig. 1. SEM images of EGF sample after chemical (left) and ion (right) etching.

In particular, it is shown that granular (block) structure is modified unequally by non-uniform strains along the films growth direction: fractal dimensionality of them changes with depth of ion etching.

References

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[2] V. Berzhansky, A. Nedviga, V. Vishnevskii, A. Prokopov. Solid State Phenomena Vol. 152-153 (2009) pp. 11-14.