Post-annealing effect of YIG ferrite thin-films epitaxially grown by reactive sputtering

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YIG (yttrium iron garnet) ferrite was useful material for magnetic devices such as isolator, circulator, MSW filter, waveguide and etc. because it has low magnetic loss at high frequencies. Recently one of authors has succeeded in preparation of epitaxial YIG ferrite thin-films in combination of sputter-deposition at ambient temperature and subsequent post-annealing at temperatures above 700 ℃ in the air. [1] Post-annealing temperature dependence of the YIG ferrite thin-films has been already reported.[2] In this paper, effects of post-annealing time was studied.

2.6-2.8 μm thick amorphous Y-Fe-O thin-films were deposited on GGG (111) substrates using reactive RF magnetron sputtering method with $Y_{2.84}Fe_{5.16}O_{12}$ ferrite sintered target. After that, the thin-films were post-annealed in air at a temperature higher than 650 degrees Celsius to be crystallized. In the XRD diagrams, diffraction peaks from only (444) or (888) plane were observed in all the samples post-annealed at over 700 degrees Celsius. As shown in figure 1, diffraction peaks from YIG (888) plane shifted toward higher angle with increasing post-annealing time. The YIG ferrite film annealed for 120 min. show no lattice mismatch. The half value width in the rocking curve for YIG ferrite (888) was only 0.19 degrees. These results proved that the films have been grown in hetero-epitaxial manner on GGG (111) substrate with high orientation. The YIG ferrite thin-films had saturation magnetization of 1.6 kG, low coercivity of less than 3 Oe and small ΔH of around 70 Oe. The YIG thin-films are thought to be applicable to ultra-thin high frequency magnetic devices.

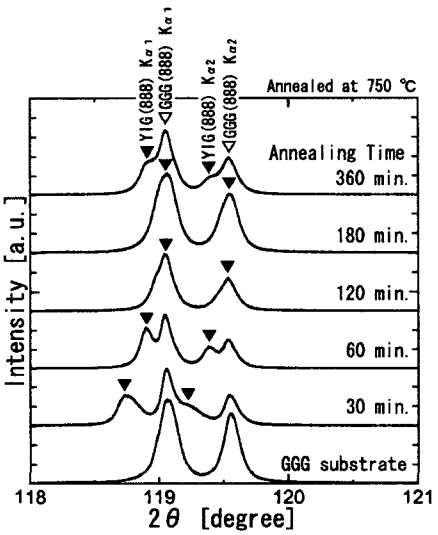

Fig.1 Effect of post-annealing time on XRD diagrams of YIG ferrite thin-films.

References

[1] Pyung Woo Jang and Ji Young Kim, IEEE Trans. on Magn., Vol.37, No.4, pp.2438-2440 (2001).

[2] Hirofumi Kuniki, SetsuoYamamoto, Tomokazu Hirano, Hiroki Kurisu, Mitsuru Matsuura and Pyung Woo Jang The 8th IUMRS International Conference on Advanced Materials, B9-10-O09 (2003).