

Fractal analysis of time-resolved magnetic domain patterns in Co/Pd multilayer with varying number of repeats

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Understanding and characterization of domain shape and reversal behavior in ferromagnetic thin films continues to be important issue from both theoretical and technological point of views. Recently, it has been reported that the detailed shape and the reversal behavior of the magnetic domain is closely correlated, where the fractal dimension D_f characterizing the shape of the domain has been found to be inversely related to the reversal parameter V/R representing the counterbalance between the wall-motion speed V and the nucleation rate R of the domain.^[1] However, systematic investigation on the correlation is still lacking. In the present work, we investigate the fractal behavior of magnetic domain together with analysis of dynamic reversal behavior in Co/Pd multilayer films prepared with the same conditions except the number of repeats. We utilize a novel magneto-optical microscope magnetometer technique to visualize the time-resolved domain evolution patterns in these films.^[2] In Fig. 1(a), we demonstrate typical domain evolution patterns of $(4\text{-}\text{\AA}\text{ Co}/11\text{-}\text{\AA}\text{ Pd})_n$ multilayer films with varying n from 5 to 15, where the color code represents switching time at each pixel. Quantitative analysis of the time-resolved domain evolution patterns allows us to determine the D_f and the V/R depending on n , as summarized in Fig. 1(b). As n increases, domain shape becomes more ragged and complex and thus, D_f increases. Interestingly enough, the change in D_f clearly seems to be coupled to the change in V/R with varying n , which implies that the correlation between D_f and V/R is mediated via the effect of defects in this system.

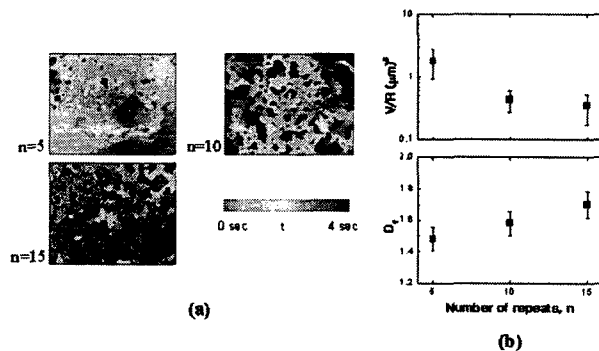


Fig.1. (a) Typical domain evolution patterns of $(4\text{-}\text{\AA}\text{ Co}/11\text{-}\text{\AA}\text{ Pd})_n$ with varying n from 5 to 15. (b) D_f and V/R for each sample.

References

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