

Evolution of stripe domains in ferromagnetic thin films

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Since the first observation of stripe domains in ferromagnetic films, i.e., since more than 50 years [1], the formation of these domains from an in-plane domain structure was considered as an abrupt nucleation process. Domains separated either by Néel or cross-tie domain walls (as shown in Fig. 1(a)), were supposed to be abruptly superimposed by stripe domains with an out-of-plane magnetization component (as shown in Fig. 1(b)). On the basis of our work, the widely used domain phase diagram [2] can now be refined. We found that the formation of stripe domains is a continuous transition and that they evolve from the domain walls at a thickness well below the critical thickness [2,3]. The latter was so far considered as a threshold for the formation of stripe domains. Local modifications induced by a perpendicular anisotropy inside the domain walls and wall junctions were observed in detail. A periodically oscillating out-of-plane magnetization is formed inside the walls. This expands throughout the in-plane domains to form stripe domains all over the film. A threshold limit for the perpendicular anisotropy inducing the evolution of stripe domains could be defined.

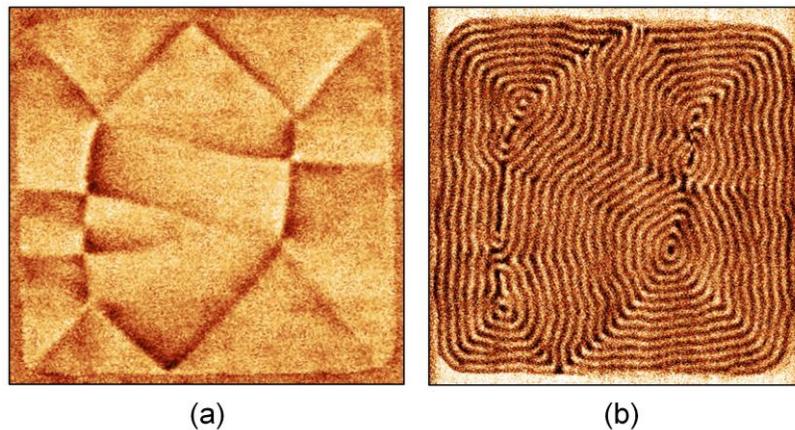


Figure 1: The magnetization configuration of a $5 \times 5 \mu\text{m}^2$ Permalloy film at (a) 45 nm thickness with in-plane domains separated by Néel and cross-tie walls, and (b) at 85 nm thickness with superimposed stripe domains.

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