The Formation and Coarsening of the Concertina Pattern

Jutta Steiner, Holm Wieczoreck, Rudolf Schäfer, Jeffrey McCord, Felix Otto

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The concertina is a magnetization pattern in elongated thin-film elements of a soft material. It is a ubiquitous domain pattern that occurs in the process of magnetization reversal in direction of the long axis of the small element. Van den Berg argued that this pattern grows out of the flux closure domains as the external field is reduced. Based on experimental observations and theory, we argue that in sufficiently elongated thin-film elements, the concertina pattern rather bifurcates from an oscillatory buckling mode. Using a reduced model derived by asymptotic analysis and investigated by numerical simulation, we quantitatively predict the average period of the concertina pattern and qualitatively predict its hysteresis. In particular, we argue that the experimentally observed coarsening of the concertina pattern is due to secondary bifurcations related to an Eckhaus instability. We also link the concertina pattern to the magnetization ripple and discuss the effect of a weak (crystalline or induced) anisotropy.

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