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Magnetic microstructures – a paradigm of multiscale problems. (English) Zbl 0991.82038

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Summary: Ferromagnetic materials display a complex microstructure of domains, walls, Bloch lines and singular points on scales ranging from 100μm down to a few nm. Understanding the formation and overall effects of these structures is crucial for key technological applications. At the same time the rich source of experimental data and the simple mathematical formulation makes the analysis of magnetic microstructure an excellent model problem to develop new mathematical tools for the understanding of multiscale problems, which are ubiquitous in science. In this paper we describe some basic mathematical problems and report on recent analytical progress in three areas: rigorous scaling laws, branching and dimensionally reduced theories for thin films.

For the entire collection see [Zbl 0970.62003].

MSC:

82D40 Statistical mechanics of magnetic materials
35Q60 PDEs in connection with optics and electromagnetic theory

Keywords:

magnetic microstructure; basic mathematical problems; rigorous scaling laws; branching; dimensionally reduced; thin films