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Domains and domain walls

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The concept of domains trace back to Weiss, who postulated the spontaneous subdivision of a ferromagnetic crystal into uniformly magnetized regions in which the magnetization points along different directions. These regions are now called domains, and explain why two pieces of soft iron do not necessarily attract each other at room temperature. Indirect verification of the domain concept was found by Barkhausen in the form of abrupt jumps in the magnetization process. Subsequently, Hamos and Thiessen and independently Bitter found direct evidence by imaging magnetic micropatterns. Barkhausen jumps are associated to the motion of the boundaries between different domains across the sample. These boundaries are called domain walls, and were first investigated theoretically by Bloch. Subsequently, Landau and Lifshitz put forward an all-encompassing theoretical framework based on total-energy minimization that is now regarded as the starting point of modern domain theory. In this lecture, we will address the principles of this theory to discuss the formation of domains and the different types of domain walls.