Comment on "Morphology of micromagnetics"

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Micromagnetics theory is rigorous within its own framework. Any improvement of it must address the basic assumptions, not the technique.

Micromagnetics is a rigorous theory for perfect single-crystal ferromagnets of well-defined shapes, at sufficiently low temperatures. Every step of it has an accurate mathematical proof, and there is no way for any theory to obtain different results *under the same assumptions*. Linearizing of the differential equations is fully justified, when used for evaluating the nucleation field and modes, because these are cases in which the nonlinear terms are negligible. The theory fails to agree with experiment only where the basic assumptions fail, namely where surface roughness and crystalline imperfections, or thermal fluctuations, are not negligible.

These facts are discussed in the references quoted by Pinto,[1] who advocates replacing micromagnetics by catastrophe theory. But he did not use them, and did not solve any particular problem, with or without adding the imperfections that are needed for making the theory of micromagnetics more realistic. He just says that it needs to be changed.

The presentation of Pinto is incorrect in the statement that "the *theoretical* nucleation field may be as large as 500 Oe while the experimental value in the same conditions is below 0.1 Oe." Actually, the theoretical value (for bulk Fe) is about 560 Oe, while the experimental nucleation field is[2] about 540 Oe, in the most perfect parts of particularly good iron crystals. For granular Fe in a Cu matrix, the experimental coercivity is[3] 526 Oe. Moreover, this particularly untypical value of 560 Oe is exactly the same for coherent and incoherent magnetization reversals,[4] in spite of the implications in Pinto's discussion section. The difference between coherent and incoherent reversals can be seen only in much smaller particles, for which the theory also agrees quite well with experiments that are within the framework of the theoretical assumptions.[5] True, the experimental value for Fe is less than 0.1 Oe in less perfect crystals, but this discrepancy can only be resolved by allowing the theory to take the imperfections into account.

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