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Size of laminar domains in a superconducting ferromagnet

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It has been thought for a long time that superconductivity and ferromagnetism could not coexist in a same material. However, superconductivity has recently been observed experimentally in the ferromagnetic phase of various Uranium compounds. This feature probably results from an unexpected kind of superconducting pairing – triplet – which is still not so much understood theoretically. Among the most unconventional examples is URhGe, where a re-entrant superconducting pocket is observed under the application of a significantly large magnetic field [1]. In this system as in the two other compounds UGe2, and UCoGe the Curie temperature is much higher than the superconducting critical temperature which means that superconductivity appears in the ferromagnetic state where it is usually a domain structure (DS) which develops. In a previous work, the influence of the superconducting screening currents on the DS has been studied in the case of thick or bulk systems, when the dimension along the easy magnetization direction is much larger than the transverse domain size and the London penetration depth [2]. We extend this work to any thickness and we discuss the DS in all limits [3]. Furthermore we investigate the possible different effects of singlet and triplet superconductivity on the DS, as well as the conditions for the existence of vortices in the domains. The results are then applied to the DS in URhGe, UGe2, and UCoGe.

Références

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