Magnetization reversal modeling for long ferromagnetic nanotubes

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Self-assembled, one-dimensional, ferromagnetic nanostructures have been attracting attention for more than ten years by now. Recently, beside nanorods which have already been well described in the literature, the growth of ferromagnetic nanotubes has been reported [1]. What makes such structures particularly interesting is the possibility to place a semiconductor material inside ferromagnetic nanotubes (Ge/Co in the case of Ref. [1]), thus forming hybrid nanocables. In evaluation of such structures an important question may be asked, namely what is the magnetization state of such a system. Thus the problem of magnetization of hollow ferromagnetic tube must be addressed. To answer this question we have reconsidered the theory of infinite hollow tube magnetization [2]. For this purpose standard micromagnetic simulation package OOMMF [3] has been used. To account for elongated geometry of the nanotubes (structures described in Ref. [1] have an aspect ratio exceeding one thousand) we have written an extension module allowing to apply periodic boundary conditions in one dimension [4]. Results of our modeling show basic agreement with the theory of Lee and Chang (Fig. 1). We describe the limitations of our approach and discuss the check-points that should be made in finite difference simulations performed for such structures.

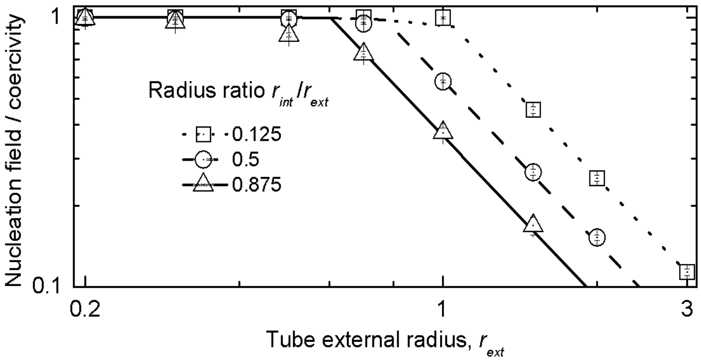

Fig. 1. Simulated coercivity compared to the theory of the nucleation field. Horizontal and vertical axis are in normalized units (see [2]).

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