THE EFFECT OF CROSS-SECTION GEOMETRY AND SIZE ON MAGNETOSTATIC MODES IN NANORODS

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We have determined numerically the local dipolar field profile and the corresponding spectrum of magnetostatic modes in nanorods of circular or square cross section. The long-range character of dipolar interactions was fully taken into account in the calculations, although we have confined our study to excitations propagating along the central axis of the nanorod (the central axis approximation); at the same time, the direction of the central axis was assumed to correspond to that of the magnetization of the sample. By comparison of results obtained for nanorods of different cross-section shape we have found that a modification of the cross-section geometry results in *non-uniform* changes in the local field profile and that the character of these cross-section shape-related local field alterations strongly depends on the lateral dimensions of the nanorod. Being the most significant in the central part of quasi-cubic nanorods and at the ends of smooth rods, the effect of the cross-section geometry on the local field profile is found to be especially strong in the range of nanometer lateral dimensions. It is also reflected in the spectrum of magnetostatic modes in the nanorod. An analysis of the correlations found to occur between the dipolar local field profile and the spectrum of magnetostatic waves has led us to the finding that some magnetostatic modes in nanorods have a peculiar feature of being associated with a specific region and any change in the local field in this region affects first of all the mode associated with it. This is why the effect of the cross-section geometry on the magnetostatic spectrum of the nanorod is the most significant in peripheral regions of smooth rods. This is due to the occurrence of dipolar local field wells in these very regions; the shape of these wells affects first of all bulk-dead modes, which are confined to the peripheral wells; frequencies of these modes prove to increase when the cross-section shape changes from square to circle. However, also bulk modes are found to respond to local field changes in the wells; this, in our opinion, is due to a “virtual” bond between bulk modes and the well regions due to the long-range character of dipolar interactions.

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