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Mechanics of Elastic and Viscous Magnetic Filaments

Andrejs Cebers, I. Javaitis

Institute of Physics, University of Latvia, Salaspils-1, Latvia

Dynamics of elastic magnetic rod in magnetic fields is considered. Rod in static magnetic field has U like metastable states. In rotating field rod has bent shape rotating synchronously with the field and undergoes the periodic motion with subsequent straightenings and bendings at high frequencies. The model of elastic magnetic rod may be applied to describe the chains of magnetic particles in magnetorheological suspensions which are held together by magnetic attraction forces. The critical frequency of chain breaking agrees well with the existing experimental data. In simplified case the nonlinear PDE of the rod dynamics in the rotating field is analogous to the equation for the tangent angle of elongated viscous magnetic drop. In this case the propagation of the tangent angle shockwave is found which allows to interpret the experimental observations. Buckling of the magnetic particle chains in magnetotactic bacteria and other biological applications are considered.
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