Mater Sci Nanotechnol 2018, Volume 2

THERMODYNAMICS OF METAMAGNETOELECTRIC EFFECT IN MULTIFERROICS

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Magnetoelectric coupling factor in multiferroics give rise to various properties such as metamagnetoelectric effect since an external field act. In this study, a general thermodynamic framework is developed to investigate metamagnetoelectric effects in multiferroic materials. The model used is a quasi-two-dimensional frustrated spin chain controlled by a static electric field in y direction and magnetic field in z-direction. The effects of metamagnetoelectric transitions on entropy, specific heat and on the linear magnetoelectric coupling factor are assessed using Fermi Dirac statistics of quantum gases and the Landau theory. The entropy behavior is shown like that of the magnetic susceptibility. In fact, while the magnetic susceptibility characterizes the variations of magnetization and accordingly emphasizes the ferroic transition points of this order, the intrinsic physics of these transition points highlights a muddle occurring due to a rearrangement of magnetic moments in the system, and this is accurately described in terms of entropy. The transition effects due to this rearrangement described in terms of entropy at the corresponding critical points show different loop to that of the specific heat. The opposite loop showed by the specific heat compared to the entropy is its weakening at the exact transition point despite its strengthening during the transition process. The temperature dependence of the magnetoelectric coupling highlights how it is continuously weakened beyond the transition point. This shows for any point defined by a pair of values of electric and magnetic fields, the range of temperature which allows metamagnetoelectric effect and how it vanishes continuously when the temperature increases.