ANTIFERROMAGNETIC AND ELECTRIC DOMAINS IN MULTIFERROIC $BiFeO_3$

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Recently, oxide multiferroics have attracted much attention. Due to large magnetoelectric effect in these materials the tuning of magnetic properties with electric field and vice versa is possible. Such multiferroics are very promising for such application in spintronics as multiple-state memory devices with dual magnetic and electric control.

One of most promising from its application point of view is multiferroic $BiFeO_3$, which shows both ferroelectric (T_C=1143K) and antiferromagnetic (T_N=643 K) ordering at room temperature. For the technical application of $BiFeO_3$ it is important to know its domain structure. Antiferromagnetic order makes the description of the domain structure in this material more difficult. It is caused by the fact that the antiferromagnetic domains nature isn't entirely known. Because of the net magnetization absence in antiferromagnetic materials there are no sources of the long-range demagnetization forces, which in ferromagnets cause the domain structure formation.

In the present paper we study the competition between antiferromagnetic and electric domain in $BiFeO_3$ crystal. Our model is based on the assumptions about magnetoelastic nature of antiferomagnetic domains and the presence in samples of finite sizes so called "destressing" energy, which is similar to the demagnetization energy in ferromagnets. In the framework of the phenomenological model, taking the destressing energy into account, it is shown that in certain conditions the electric and the antiferromagnetic domains in the $BiFeO_3$ sample are strongly interrelated. This fact makes it possible to control the electric polarization by means of magnetic field.