Theoretical Description of Relaxor Ferroelectric

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Relaxor ferroelectrics, or relaxors exhibit many properties similar to those of spin or dipolar glasses. Relaxor behavior in normally ferroelectric materials results from compositionally inherity, disorder or frustration. Because there are similarities between spin glasses and relaxor ferroelectric, Ising model description of spin glasses has been attempted by many authors.

In spite of several attempts, the nature of diffused phase transition in relaxor ferroelectric has still remained in a controversial stage. Experimental evidence in them showed incompatibility with the assumptions of fixed length ordered parameter as proposed in dipolar glasses or spin glasses. Because of basic reorientable polar nanoclusters i.e the "pseudospins" very in both in their size and orientation, the relaxor corresponds to new type of dipolar glasses namely spherical vector glasses and the order parameter field is described as a continuous vector field of variable length. Pseudospin Hamiltonian of a relaxor under Spherical Random Bond-Random Field(SRBRF) model takes the form.

$$H_s = -\frac{1}{2}\sum J_{ij}\vec{S}_i.\vec{S}_j - \sum_i \vec{h}.\vec{S}_i - g\vec{E}.\sum_i \vec{S}_i \quad \text{.....1}$$

Inclusion of pseudospin lattice coupling interaction, for the nanodomains are being dispersed in a deformable lattice, the total Hamiltonian now becomes

$$H = H_S + H_L + H_{SL} \quad \text{.....2}$$

where H_L and H_{SL} are the lattice (phonon) contribution and pseudospin polar phonon respectively. The phase transition to an inhomogeneous ferroelectric state occurs below transition temperature T_c given by

$$kT_c = J_0^*\left[1-\frac{\Delta}{(j_0^*)-(j^*)^2}\right] \quad \text{.....3}$$

In summary ,the coupled SRBRF- phonon model of relaxors appears to be successful in explaining the reloxor properties of ferroelectrics. Experimental work on relaxor ferroelectrics are in progress.

Key wards : Relaxor ferroelectric, pseudospin, spin glass model, SRBRF model, nanodomains.