초청강연 2

DETERMINATION OF RELAXATION TIME DISTRIBUTION IN DIPOLE GLASS AT LOW TEMPERATURES[+]

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Dipole glass obtained from mixed crystals between ferroelectric and antiferroelectric components has played an important role as a model system to understand the glass freezing dynamics of the amorphous structural glasses because the dipole glass systems have relatively well defined interaction Hamiltonians, underlying lattice periodicity, and optical transparency in addition to the two essential characteristics of randomly competing interactions and frustrations required to form the glass.

Glass freezing is characterized by a broad distribution of relaxation times and a very slow relaxation time described by the empirical Vogel-Fulcher law. It used to be that the broad distribution of relaxation times was assumed as a symmetric Gaussian function or a flat streight line to best fit the observed dielectric constant data in the limited range of low frequency measurements.

We want to report our work to find the relaxation time distribution function g(τ) defined as

$$\varepsilon^*(\omega) = \varepsilon(\infty) + \Delta\varepsilon \int_0^\infty g(\tau)/(1+i\omega\tau)d(\ln\tau)$$

in the well-known dipole glass system of DRADP-x mixed crystal between ferroelectric DRDP and antiferroelectric DADP components. The low frequency dielectric constant data as a function of temperature was analyzed by use of the Tikhonov regularization method of data analysis[1,2] to obtain g(τ) as a function of temperature.

These determinations of g(τ) enabled us to obtain the temperature dependence of the average relaxation time $<\tau>=\int \tau g(\tau)d(\ln\tau)$, the distribution width of relaxation times $\tau_{var} = \int(\tau - <\tau>)^2 g(\tau)d(\ln\tau)$, and the asymmetry of the distribution $\tau_{skew} = \int(\tau - <\tau>)^3/(\sqrt{\tau_{var}})^3 g(\tau)d(\ln\tau)$, as a function of temperature.

The results will be discussed for comparisons among different systems of slow glassy dynamics.

[1] H. Schaefer et al., Phys. Rev. Lett. 76, 2177(1996).
[2] B.-G. Kim and J.-J. Kim, Phys. Rev. B55, 5558(1997).

[+] Supported in part by Korea Science and Engineering Foundation (RCDAMP-Pusan National University).
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