Broadband Light Scattering and Second Harmonic Generation in Ferroelectric Nanocrystals

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A stability of ferroelectricity is important in the practical application with reduced spatial dimensions in the nanometer size regime. Much interest has focused in recent years on ferroelectric nanostructure crystals, because of the clarification of the physical origin in the size effect of ferroelectricity and the technological development in the miniaturization of multilayer ceramic capacitors (MLCC) and ferroelectric non-volatile memory devices. The correlation length of polarization fluctuation was estimated as 10-50 nm above the ferroelectric phase transition point.[1] From the viewpoint of the polarization fluctuation the size effect should be remarkable below the correlation length. Furthermore, as a new topics of ferroelectric nanocrystals the toroidal like ferroelectrisity has recently been proposed in $BaTiO_3$ and related materials from ab initio study by Naumov and Bratkovsky.[2,3] In the present study, the property of polarization fluctuation and symmetry breaking has been studied in $BaTiO_3$ nanocrystals with sizes of 17 nm and 30 nm using broadband light scattering and second harmonic generation (SHG). The temperature dependence of broadband light scattering spectra on a log-log plot was obtained in Figure 1. The spectra have a central peak component. The line width of central peak shows anomaly around 350 K at which the temperature dependence of SHG signal also shows anomaly. The dynamical behavior of the ferroelectric phase transition will be discussed in $BaTiO_3$ nanocrystals in comparison with one of a bulk $BaTiO_3$ sample.

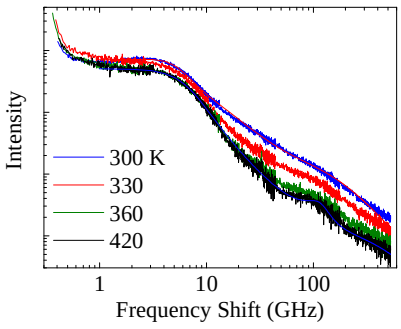

Figure 1. The broadband light scattering spectra in $BaTiO_3$ nanocrystals.

References

1. M. E. Lines and A. M. Glass, Principles and Applications of Ferroelectrics and Related Materials, Oxford 1977.
2. I. Naumov et al., Nature **432**, 737 (2004)
3. I. Naumov and A. M. Bratkovsky, Phys. Rev. Lett. **101**, 107601 (2008)