Dynamical disorder of the π-molecular-skeleton structures in the hydrogen bonded organic ferroelectrics

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A new class of room-temperature hydrogen-bonded ferroelectrics has been recently developed in the family of organic molecular solids and is now of great interest in the light of emerging organic electronics [1]. The prototypical example is the proton-order-disorder-type ferroelectrics 55DMBP-H_2ia, in which 55DMBP and H_2ia molecules are interconnected with the hydrogen bond and form a supramolecular chain as shown in Fig. 1. The collective intermolecular proton transfer induces the electric polarization accompanying the polar molecular distortion via the strong proton-π-molecular skeleton interaction. In this presentation, we report the proton-mediated polarization-π-molecular skeleton coupled dynamics in these emerging organic ferroelectrics investigated by the infrared-spectroscopy [2]. The imaginary part of the dielectric spectra are shown in Fig. 2. Almost all of the vibrational modes below 500cm^{-1} are anomalously blurred and amalgamated into the lower lying polarization relaxation mode in the course of ferroelectric-to-paraelectric transition concomitant with the melting of the proton ordering. This suggests that the molecular shape is no more well-defined at the proton disordered paraelectric phase. The possible origin for such an anomalously large fluctuation of the π-molecular skeleton structure is discussed in terms of the dynamical proton disorder in the bifurcated intermolecular hydrogen bond.

Fig. 1

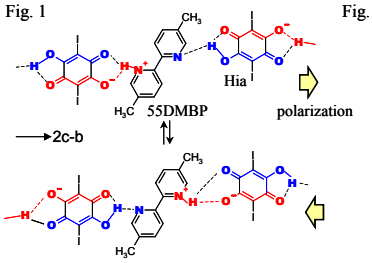

Fig. 2

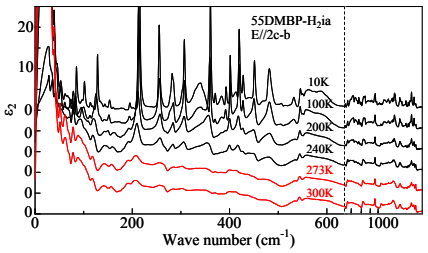

Fig. 1 The schematic view of the molecular structure.
Fig. 2 The imaginary part of the dielectric spectra for E//2c-b (supramolecular chain)

[1]S. Horiuchi *et al.*, Angew. Chem. Int. Ed. 46, 3497(2007).
[2]J. Fujioka *et al.*, Phys. Rev. Lett. 102, 197601(2009).