Ferroelectricity and Supramolecular Assembly of Chiral and Racemic Alkylamide Substituted Benzene Derivative

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A simple 1,3,5-trialkylamide-substituted benzene derivative (3BC) indicated an excellent ferroelectricity in discotic hexagonal columnar (Colh) liquid crystalline (LC) phase. 1 On the other hand, asymmetrical LC material based on helical columnar assembly of chiral S-3BC can also exhibit the ferroelectric polarization due to chiral molecular and assembly structures. 2 Surprisingly, the magnitudes of coercive electric field (E_c) of S-3BC was 13-times smaller than those of 3BC. In this work, we prepared R-3BC and fabricated equally mixed system of (S-3BC)(R-3BC) to obtain racemic rac-3BC, which revealed the effect of chiral alkylamide chains (Scheme.1).

Assembly structures, phase transition behaviors, dielectric properties, and ferroelectric responses of these were examined and compared to each other.

The same chemical structures of S-3BC, R-3BC, and rac-3BC show similar phase transition behaviors and molecular assembly structures, and the solid – Colh and Colh – isotropic phase transition temperatures of these were observed at 388 and 511 K, respectively. Interestingly, although both chiral and racemic molecules showed the ferroelectricity in Colh phase at the low frequency measurements, the magnitude of E_c of rac-3BC was more than 10 times larger than those of chiral S-3BC and R-3BC (Fig. 1). The polarization and rotation of the chiral alkylamide groups easily occurred by the outer electric filed, where the energy for the polarization inversion was drastically reduced in chiral molecular system.