

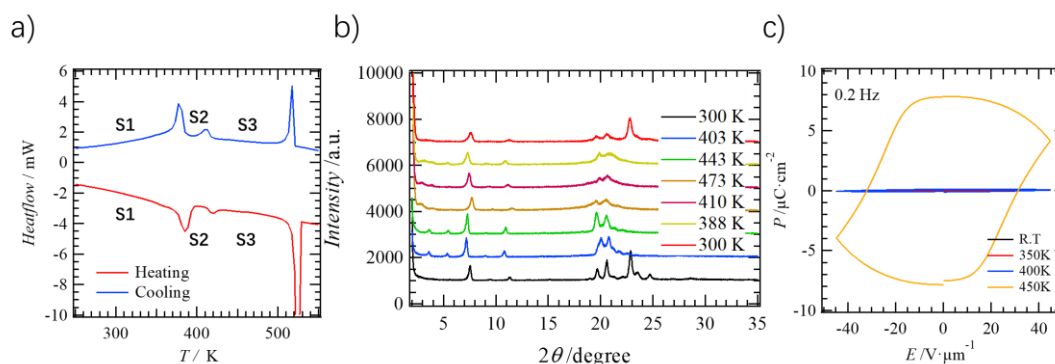
## Ferroelectric Alkylamide-Substituted Stilbene Derivative

(<sup>1</sup>Graduate School of Engineering, Tohoku University, <sup>2</sup>Institute of Multidisciplinary Research for Advanced Materials, Tohoku University) ○Yunya Zhang,<sup>1</sup> Takashi Takeda,<sup>1,2</sup> Tomoyuki Akutagawa<sup>1,2</sup>

**Keywords:** Ferroelectricity; Phase transition; Alkylamide; Stilbene; Dipole inversion

Thermally activated motional freedom of alkyl amide ( $-\text{CONHC}_n\text{H}_{2n+1}$ ) chains enables the dipole inversion of polar  $\text{N}-\text{H}\cdots\text{O}=\text{O}$  hydrogen-bonded chains and ferroelectric response by the application of the outer electric field. Double hydrogen bonding between amide units fixes the  $\pi$ -stacking structure at the  $\text{C}=\text{C}$  double bonds of stilbene. Herein, we focused on a photo-responsible stilbene derivative with two tetradecyl amide ( $-\text{CONHC}_{14}\text{H}_{29}$ ) chains (**C14SDA**) in order to fabricate multifunctional organic ferroelectrics.

**C14SDA** was synthesized from the corresponding dicarboxylic acid, and its phase transition behavior, molecular assembly structure, and ferroelectricity were investigated. The DSC trace shows the solid-solid phase transitions at 386 K (S1–S2) and 415 K (S2–S3) and indicates a melting point at 523 K (Fig. 1a). The powder X-ray diffraction patterns show the change in the ordering states of molecular assembly from S1, S2, to S3 phases. The partial melting state of alkyl chains was observed in the S3 phase from the appearance of a broad diffraction peak around  $2\theta \sim 20^\circ$ , suggesting the dipole inversion of hydrogen-bonding amide chains (Fig. 1b). The temperature-dependent polarization–electric field ( $P$ – $E$ ) curves of high temperature S3 phase at 450 K shows a hysteresis behavior at the frequency of 0.2 Hz, which corresponds to the ferroelectricity (Fig. 1c). The remanent polarization ( $P_r$ ) and the coercive electric field ( $E_c$ ) of **C14SDA** were  $7.8 \mu\text{C cm}^{-2}$  and  $31 \text{ V } \mu\text{m}^{-1}$ , respectively, at 460 K. Similar motional freedom of polar amide groups has been observed in *N, N'*-bis(tetradecyl)-1,4-benzenedicarboxamide (**C14TPA**),<sup>[1]</sup> where the thermal melting of alky chains supports the polarization inversion even in the solid state.



**Fig. 1.** a) DSC curve, b) PXRD patterns in heating and cooling processes, and c) temperature-dependent  $P$ – $E$  curves of **C14SDA**.

1) M. Kawana, et al., *J. Mater. Chem. C*, **2022**, *10*, 4208–4217.