Ferroelectric and piezoelectric properties of newly synthesized vinylidene fluoride telomer with C_nF_{2n+1} group

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Organic ferroelectric thin films have been well studied in recent years due to their applicability to transducers, sensors, actuators and memory devices. Poly vinylidene fluoride (PVDF) and its copolymer with trifluoroethylene, [P(VDF/TrFE)] are well known to be ferroelectric polymers. However, it is difficult to fabricate the highly oriented polymer films with high crystallinity. Here, we focused on newly synthesized vinylidene fluoride (VDF) telomer [$C_6F_{13}(CH_2CF_2)_{23}I$] with low-molecular-weight. Ferroelectric and piezoelectric properties of its highly oriented thin film deposited by vacuum evaporation method were investigated. **Figure 1** shows the *D-E* hysteresis characteristic of Al/VDF/Al capacitor. The VDF telomer films showed clear hysteresis loop, and the corresponding value of remanent polarization (P_r) was 100 mC/m^2. The value of P_r was tend to be smaller than that of $CF_3(CH_2CF_2)_{17}I$ (130 mC/m^2)[1]. This result may indicate that the R_F (C_nF_{2n+1}) group is invalid for P_r. We also measured the piezoelectric response of the evaporated film of VDF telomer (**Fig. 2**). The piezoelectric coefficient d_{33} calculated from the relationship between the applied stress rate and output current was estimated to be 268 pC/N, which is higher than that of $CF_3(CH_2CF_2)_{13.4}C_2H_5$ (181 pC/N)[2]. These results suggest depending on the difference of the stiffness properties arising from the R_F groups.

1. K. Noda, et al., J. App. Phys. 2003, 93, 28866-28870.
2. K. Takashima, et al., J. Robotics Soc. Jpn. 2008, 26, 711-717.

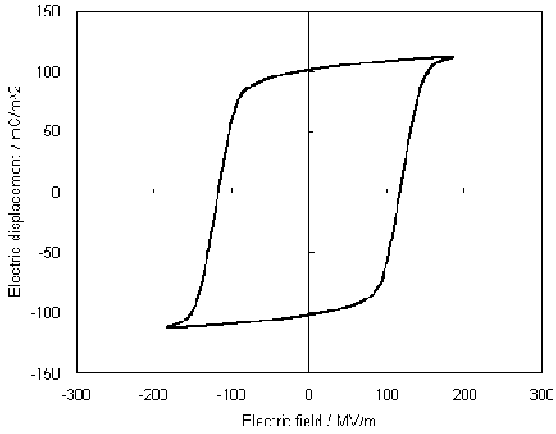

Figure 1 *D-E* hysteresis curves observed for the 300-nm-thick $C_6F_{13}(CH_2CF_2)_{23}I$ telomer film.

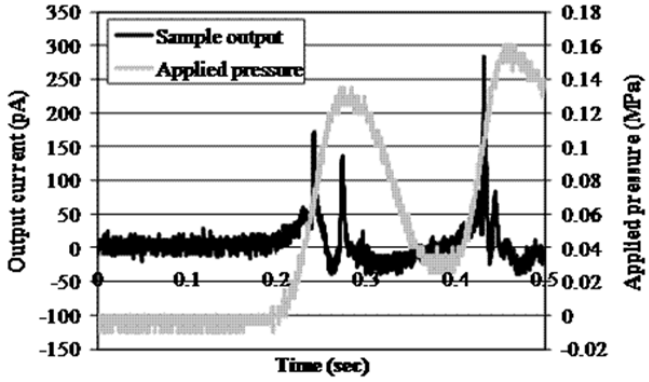

Figure 2 Piezoelectric response (black line) of $C_6F_{13}(CH_2CF_2)_{23}I$ telomer film with applying cyclic pressure stress (gray line).