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Chirality-induced relaxor properties in ferroelectric polymers

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SUPPLEMENTARY INFORMATION

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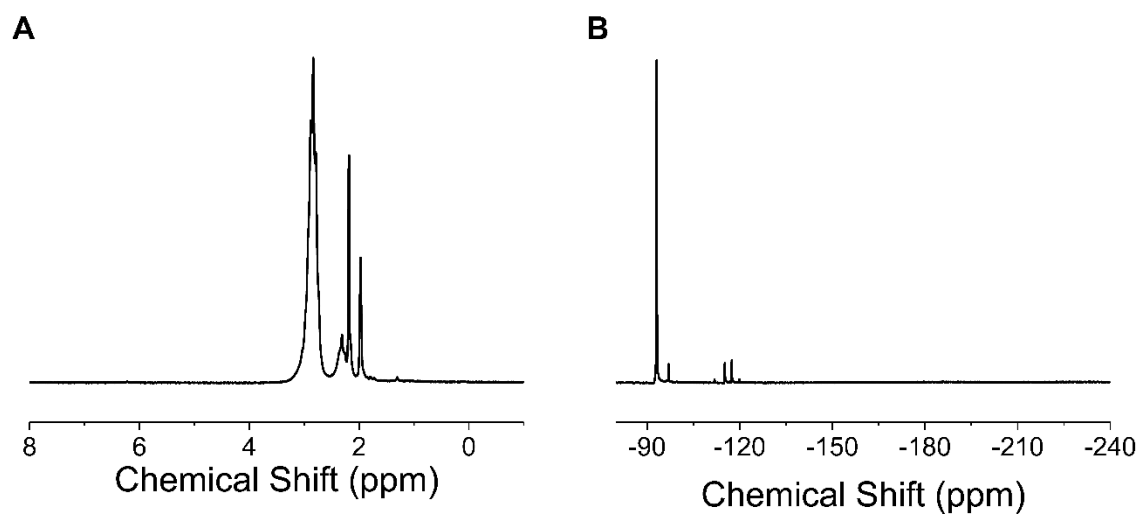
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1. Summary of electrostrictive properties of ferroelectrics

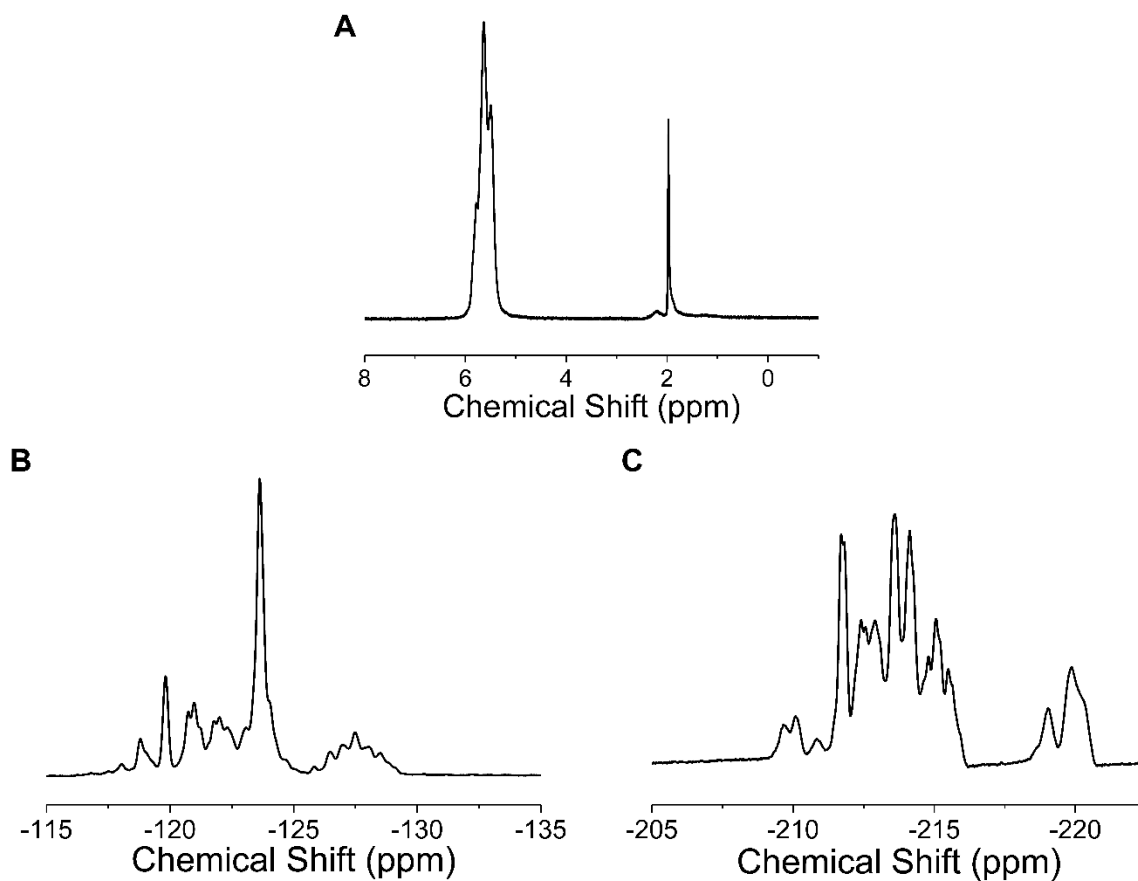
Supplementary Table 1. Summary of electrostrictive coefficients Q_{33} in ferroelectric polymers and ceramics or single crystals

Materials	Q_{33} [$\text{m}^4 \text{C}^{-2}$]	References
<i>Polymers</i>		
Irradiated P(VDF-TrFE) 50/50 mol%	-13.5	3
PVDF	-2.4	39
P(VDF-TrFE) 65/35mol%	-2.1	39
P(VDF-TrFE) 65/35mol%	-1.5	40
P(VDF-TrFE) 52/48mol%	-3.0	41
P(VDF-TrFE) 45/55 mol%	-7.0	20
P(VDF-TrFE-CFE) 61.5/30.3/8.2 mol%	-8.8	This work
P(VDF-TrFE-CTFE) 61.8/30.4/7.8 mol%	-5.3	This work
PTrFE	-30.8	This work
PCTFE	-59.6	This work
<i>Ceramics or single crystals</i>		
Pb(Mg _{1/3} Nb _{2/3})O ₃	0.025	42
Pb(Mg _{1/3} Nb _{2/3})O ₃ -0.1PbTiO ₃	0.027	43
Pb(Mg _{1/3} Nb _{2/3})O ₃ -0.28PbTiO ₃	0.050	44
Pb(Zn _{1/3} Nb _{2/3})O ₃	0.060	44
K _{0.5} Na _{0.5} NbO ₃ -0.2SrTiO ₃	0.0076	45
Ba(Zr _{0.2} Ti _{0.8})O ₃ -0.5(Ba _{0.7} Ca _{0.3})TiO ₃	0.045	46
0.97Bi _{1/2} (Na _{0.78} K _{0.22}) _{1/2} TiO ₃ -0.03BiAlO ₃	0.049	44
BaTiO ₃	0.11	47

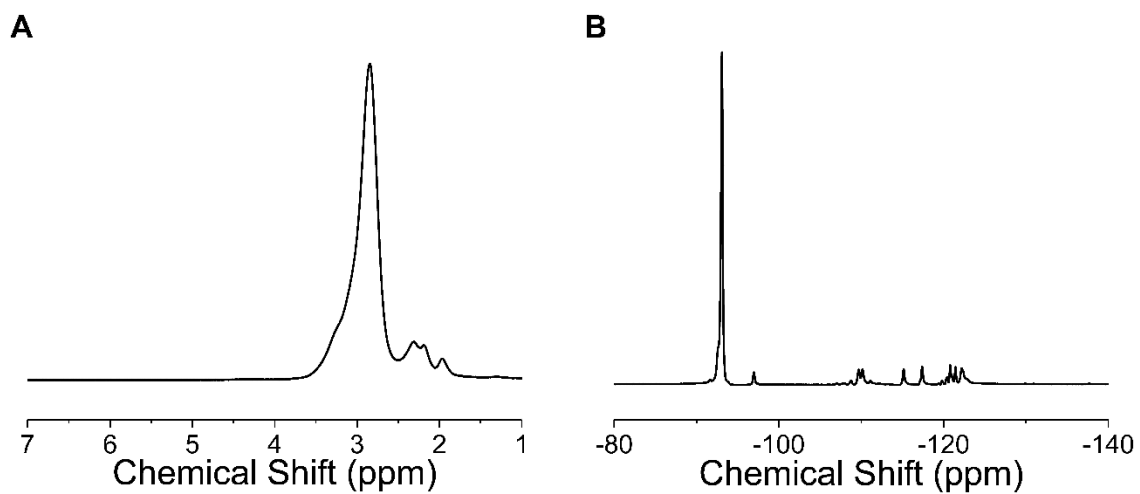
2. Nuclear magnetic resonance (NMR) spectra



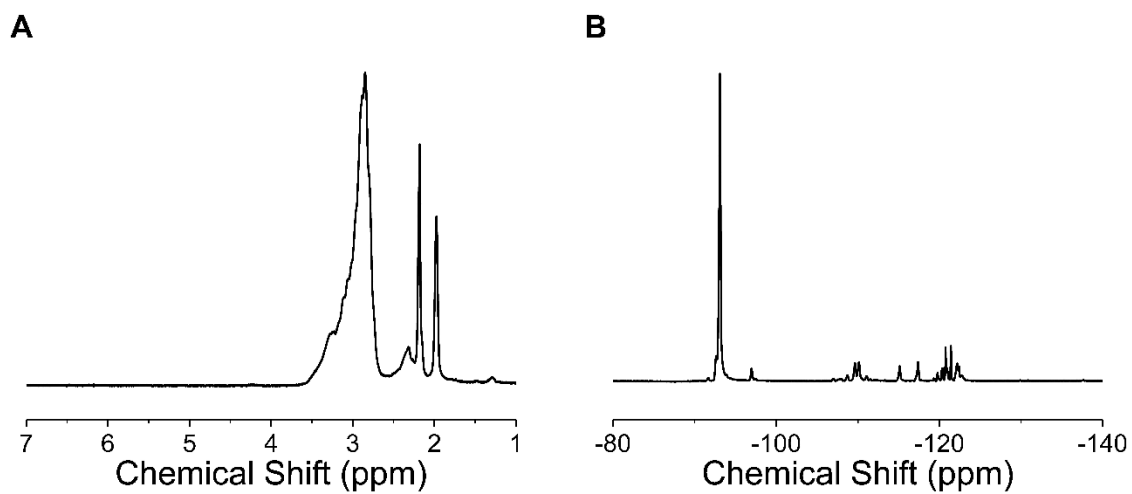
Supplementary Fig. 1. ^1H and ^{19}F NMR spectra of PVDF. (A) ^1H spectrum. (B) ^{19}F spectrum.



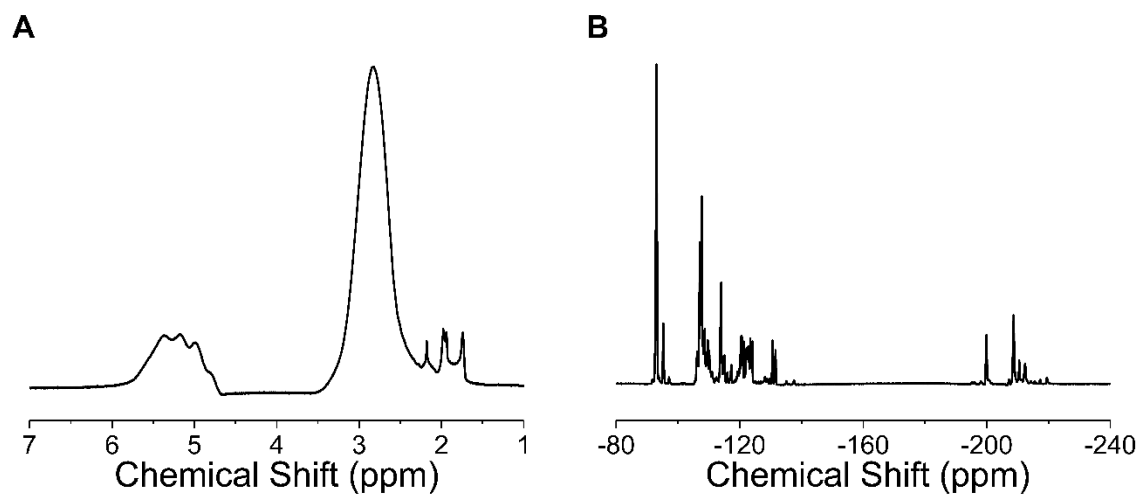
Supplementary Fig. 2. ^1H and ^{19}F NMR spectra of PTrFE. (A) ^1H spectrum. ^{19}F spectra of PTrFE in the region between -115 ppm and -135 ppm (B), and in the region between -205 ppm and -225 ppm (C).



Supplementary Fig. 3. ^1H and ^{19}F NMR spectra of P(VDF-CTFE) 90/10 mol%. (A) ^1H spectrum. (B) ^{19}F spectrum.

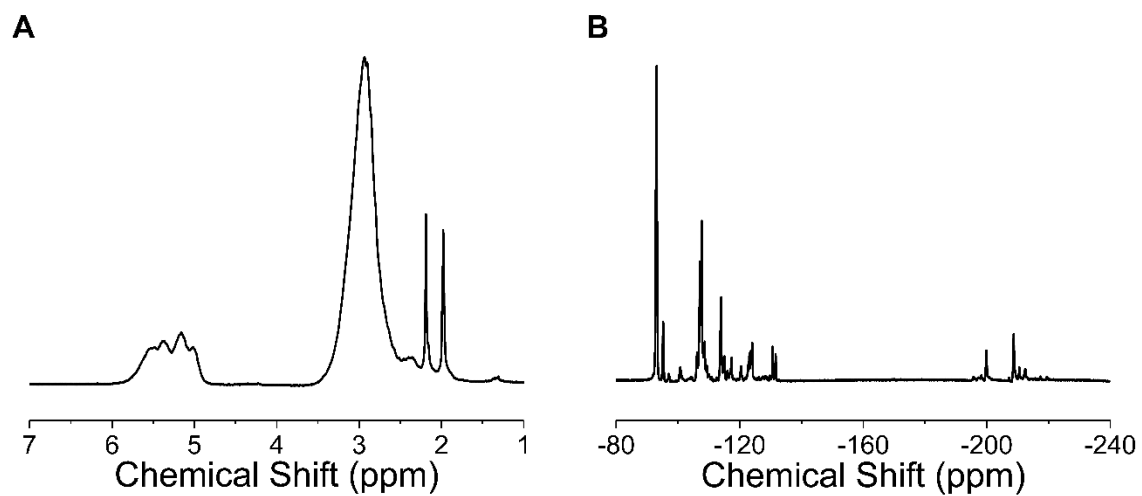


Supplementary Fig. 4. ^1H and ^{19}F NMR spectra of P(VDF-CTFE) 80/20 mol%. (A) ^1H spectrum. (B) ^{19}F spectrum.



Supplementary Fig. 5. ^1H and ^{19}F NMR spectra of P(VDF-TrFE-CTFE) 61.8/30.4/7.8 mol%.

(A) ^1H spectrum. (B) ^{19}F spectrum.



Supplementary Fig. 6. ^1H and ^{19}F NMR spectra of **P(VDF-TrFE-CFE) 61.5/30.3/8.2 mol%**.

(A) ^1H spectrum. **(B)** ^{19}F spectrum.

3. Fit of dielectric data by Vogel-Fulcher (V-F) law

Supplementary Table 2. Summary of parameters by the V-F fit to dielectric data in relaxor polymers

Polymers	T_f [°C]	$\text{Log}_{10}(f_0)$	$\text{Log}_{10}(e)E_a/k_B$
PTrFE	22.00	7.02	57.82
P(VDF-TrFE) 55/45 mol%	62.35	7.41	19.93
P(VDF-TrFE) 45/55 mol%	48.37	11.31	168.51
PCTFE	156.70	10.99	126.75
P(VDF-CTFE) 90/10 mol%	7.53	7.59	84.89
P(VDF-CTFE) 80/20 mol%	8.30	-5.28	149.29
P(VDF-TrFE-CTFE) 61.8/30.4/7.8 mol%	30.20	7.60	46.79
P(VDF-TrFE-CFE) 61.5/30.3/8.2 mol%	3.73	7.41	88.07

The newly discovered relaxor polymers in this work are shown in bold

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