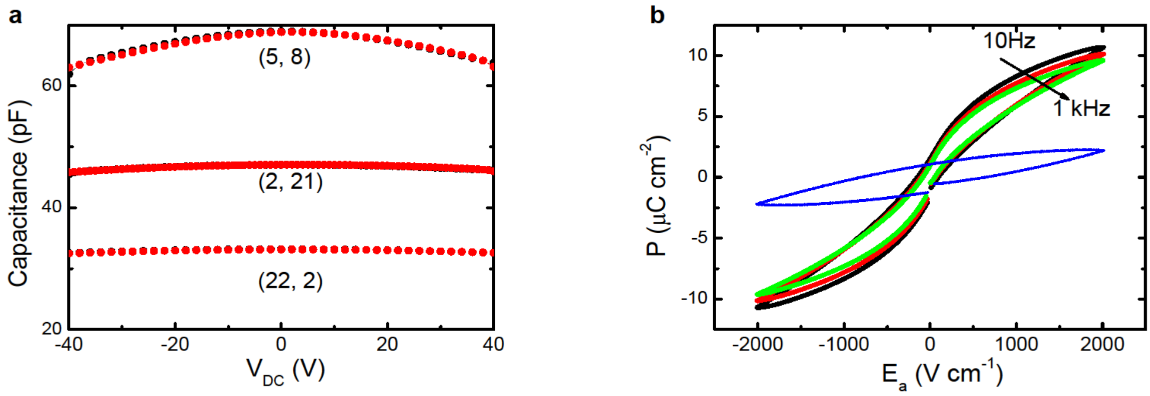
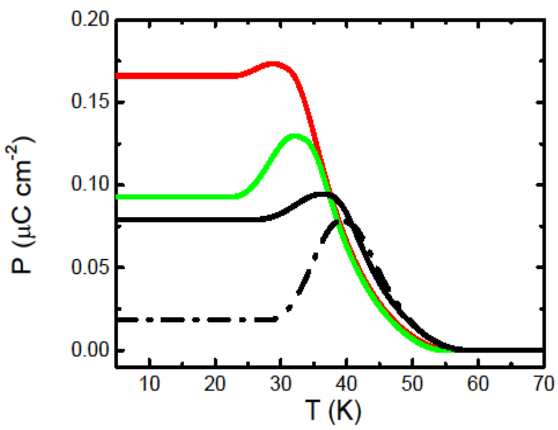
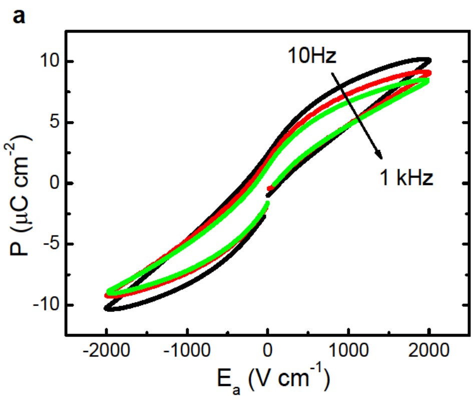
Supplementary Figures

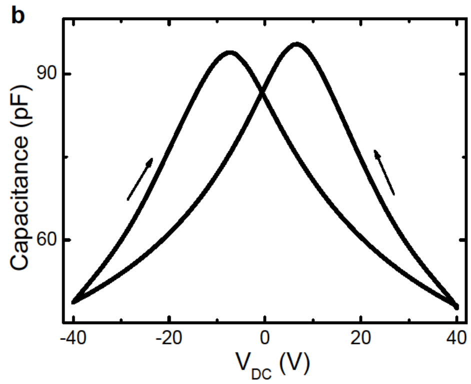


Supplementary Figure S1 │ Evidence for suppression of hysteretic effects above the ferroelectric transition temperature. (**a**) Capacitance-Voltage (C-V) characteristics of various superlattices (SLs) measured at temperatures above their corresponding ferroelectric transition temperature (T_c). Data for (5, 8), (2, 21) and (22, 2) SLs have been measured at 20 K, 25 K, and 50 K, respectively. No hysteresis between different voltage scanning directions is observed. Different scanning directions are depicted in black and red color. (**b**) Polarization versus Electric-field (P-E_a) loops for a SL with period (2, 21) above and below T_c. The *S*-like P-E_a loop observed at low temperatures (black, red and green curves measured at 5 K in 10 Hz, 100 Hz and 1 kHz, respectively) vanishes when the sample temperature exceeds T_c (blue curve measured at 30 K in 1 kHz).



Supplementary Figure S2 | Observation of thermal hysteresis in polarization measurements in zero field cooling conditions. Comparison between the temperature dependence of polarization in superlattices (SLs) with a layer period of (22, 2) in the absence of an applied magnetic field (H) under (i) electric field cooling (EFC) (black solid curve) and (ii) zero electric field cooling (ZEFC) (black dashed curve) conditions, and with H=6 T applied parallel to the plane of the SL under (iii) zero magnetic field cooling (ZMFC) (green curve) and (iv) magnetic field cooling (MFC) (red curve) conditions. Both ZMFC and MFC measurements were performed in EFC.





Supplementary Figure S3 │Hysteretic effects in a superlattice with layer period of (5, 8). (**a**) Polarization versus Electric-field (P-E_a) hysteresis loops measured at T=5 K from 10 Hz to 1 kHz. (**b**) Capacitance-Voltage (C-V) "butterfly"-like characteristic loop measured at T=5 K. Different voltage scanning directions are indicated by arrows.

Supplementary Methods

Extrinsic contribution in AC measurements. To study the ferroelectric (FE) characteristics of the superlattices (SLs) we employed different measurement techniques. This combination of measurements allows us to dispel possible extrinsic contributions[1,40,41]. Supplementary Fig. S1a depicts Capacitance-Voltage (C-V) loops for SLs measured above their corresponding FE transition temperature (T_c). The suppression of the shift in C-V above T_c indicates that such a shift is related to FE switching in the SLs. If extrinsic effects were at play, the C-V shift would have increased with increasing temperature. Furthermore, extrinsic contributions due to charge mobility and injection, or ion motion would have dominated at higher temperatures[42], and not in the low temperature regime where ferroelectricity emerges in our samples. A Charge-Voltage (Q-V) hysteresis might also arise due to extrinsic effects. However, a C-V loop would depict the characteristic butterfly shape only when the material is FE (ref. 1). Furthermore, if space charges close to the electrical contacts contributed to our measurements, we would have observed a strong asymmetry and multiple peaks in the C-V plots[43]. The smooth butterfly-loops presented in the Article dismiss such a possibility. Supplementary Fig. S1b shows a corresponding Polarization versus Electric-field (P-E_a) hysteresis loop of a SL with a layer period of (2, 21) measured below and above the FE T_c. The *S*-like P-E loop observed at low temperature vanishes when the sample temperature exceeds T_c. Furthermore, if extrinsic contributions were at play, increasing the frequency of the AC signal would result in a large difference in both the magnitude of P and the shape of the P-E_a loop[1,40,41,43]. In particular, the shape of the hysteresis loop would substantially change with frequency, with the polarization saturation vanishing at high frequency[41]. The measured polarization at 2 kV cm^{-1} decreases slightly with increasing frequency and is accompanied by a weak suppression of the coercive field E_c. This behavior indicates that the electrical dipoles do not respond fully to the applied field at high frequencies[44].

Supplementary References

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