Electronic Supplementary Information

Broad bandwidth emission and in situ electric field modulation of photoluminescence in Nd-doped ferroelectric crystals

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Experimental Section:

The Nd-doped ferroelectric crystals $(Pb_{0.97}Nd_{0.02})[(Mg_{1/3}Nb_{2/3})_{0.61}Ti_{0.39}]O_3$ [Nd:PMNT] with tetragonal perovskite structure were grown by top-seeded solution-growth method.[1] The plates were sliced along the <001> direction for electrical, photoluminescence performance measurements. The transparent indium tin oxide (ITO) was deposited on both sides of samples using magnetron sputtering system for photoluminescence response measurement. The polarization-electric field (*P*-*E*) hysteresis loop and current vs electric field (*I*-*V*) curve were measured using a ferroelectric analyzer (TF2000, aix-ACCT, Germany). The piezoresponse images before and after poling through an explanted direct current power source were observed by a piezoresponse force microscopy (PFM, Cypher ES, Asylum Research, USA) using conductive proves (ASYELEC-01, Asylum Research, USA) at room temperature. A UV/V/NIR fluorescence spectrometer (FLS980, Edinburgh Instruments, England) was used to measure photoluminescence (PL) response.

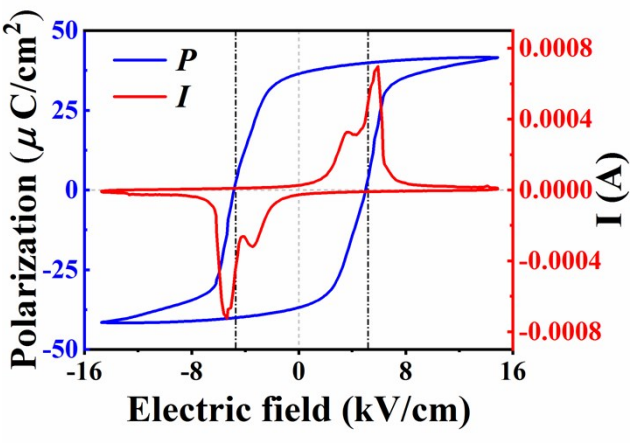

Fig. S1 The ferroelectric polarization-electric field (*P*-*E*) hysteresis loop and the current-electric field (*I*-*E*) curve of Nd:PMNT single crystal. The values of the remanent polarization (P_r) and coercive field (E_C) were 36.7 μC/cm^2 and 4.91 kV/cm, respectively.

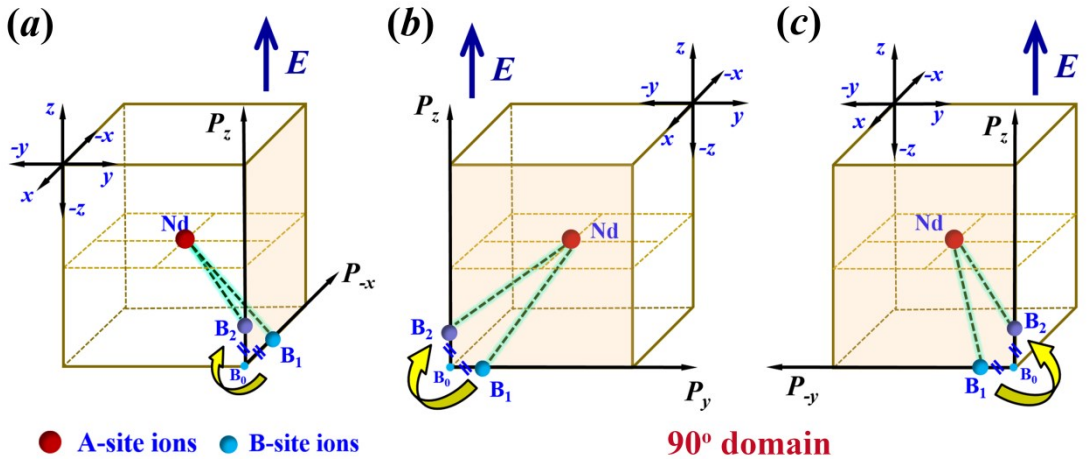

Fig. S2 Schematic diagram of the interaction between Nd^{3+} ions and B-site ions moving from a B_1 position to a B_2 position, when the 90° domains switching induced by an external electric field.

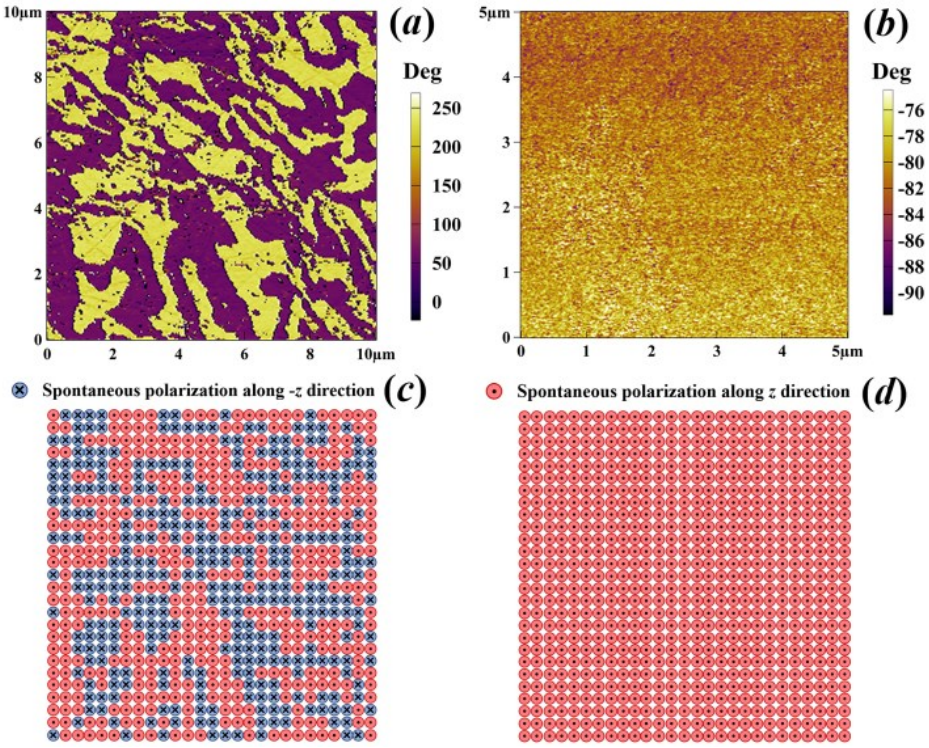

Fig. S3 The PFM phase image of a Nd:PMNT crystal under (a) zero field (10 μm×10 μm) and (b) a coercive field along the *z* direction (5 μm×5 μm). The schematic diagram is the distribution of the 180° domain (c) in the virgin sample and (d) under the coercive electric field along the *z* direction.

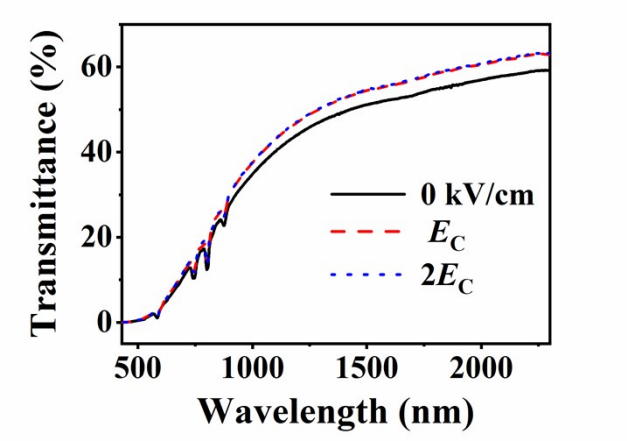

Fig. S4 Transmittance of Nd:PMNT crystals under the electric field of 0 kV/cm, E_C and $2E_C$. The transmittance was increased by about 6.4% from 0 kV/cm to E_C, and by about 0.6% from E_C to $2E_C$.

Reference

[1] X. Long, Z.-G. Ye, *Acta Mater.*, 2007, **55**, 6507-6512.