Supporting Information

Enhancement of High-Temperature Piezoelectric Properties in V/Mn Co-Doped $Sr_2Nb_2O_7$ Ceramics

Fenghong Shao [a,b], Chen Chen [a], Xiang He [a], Zhiguo Yi [a,b,*]

[a] State Key Laboratory of High Performance Ceramics, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai 200050, China

[b] Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, China *Email：zhiguo@mail.sic.ac.cn

KEYWORDS: perovskite-like layered structure materials, thermal stability, piezoelectric activity

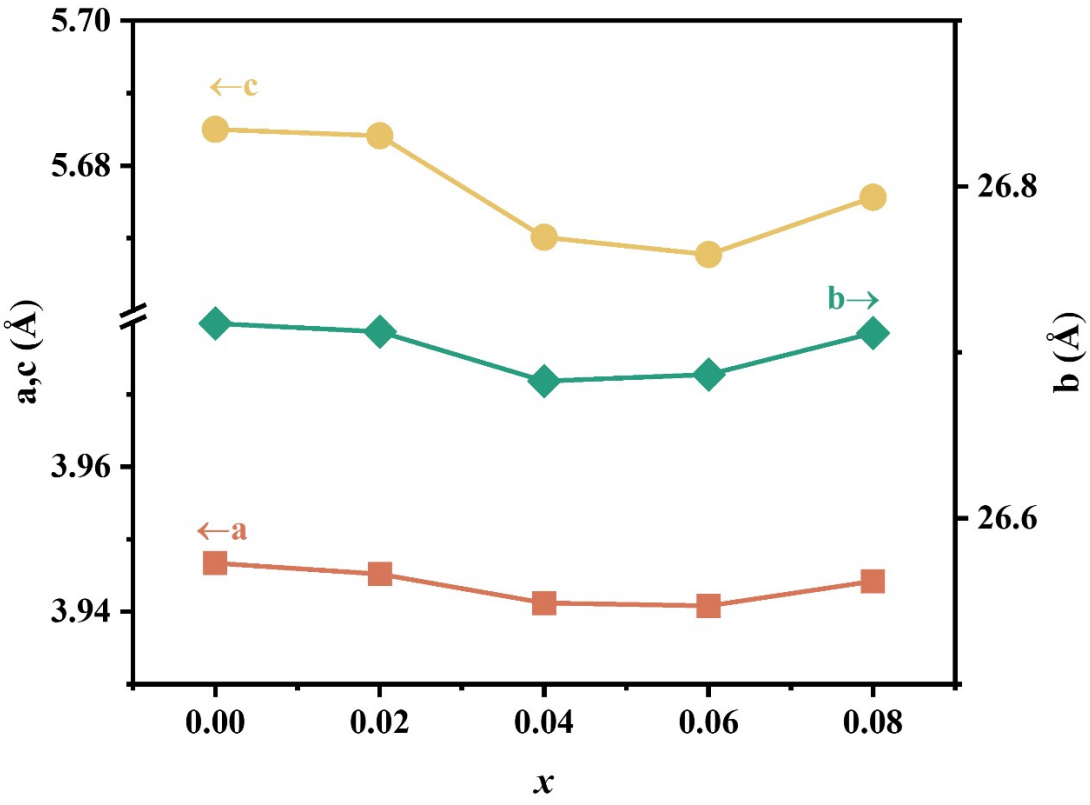

Fig. S1 variation in lattice constants (*a*, *b* and *c*) of SNVM*x* ceramics.

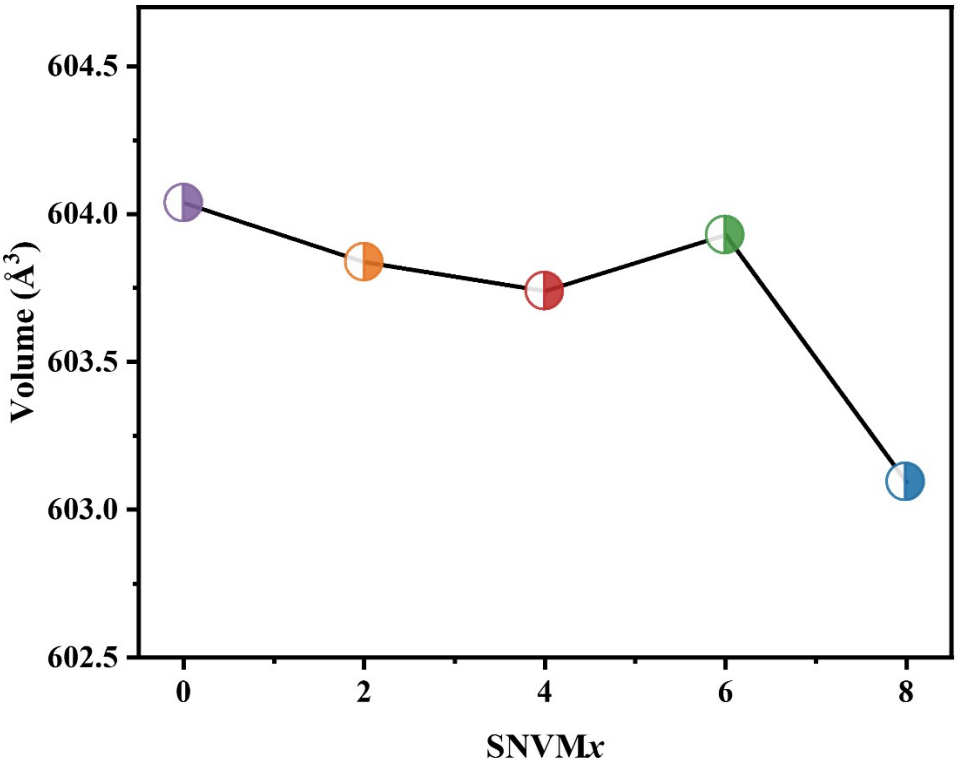

Fig. S2 Unit cell volume of SNVM*x* ceramics.

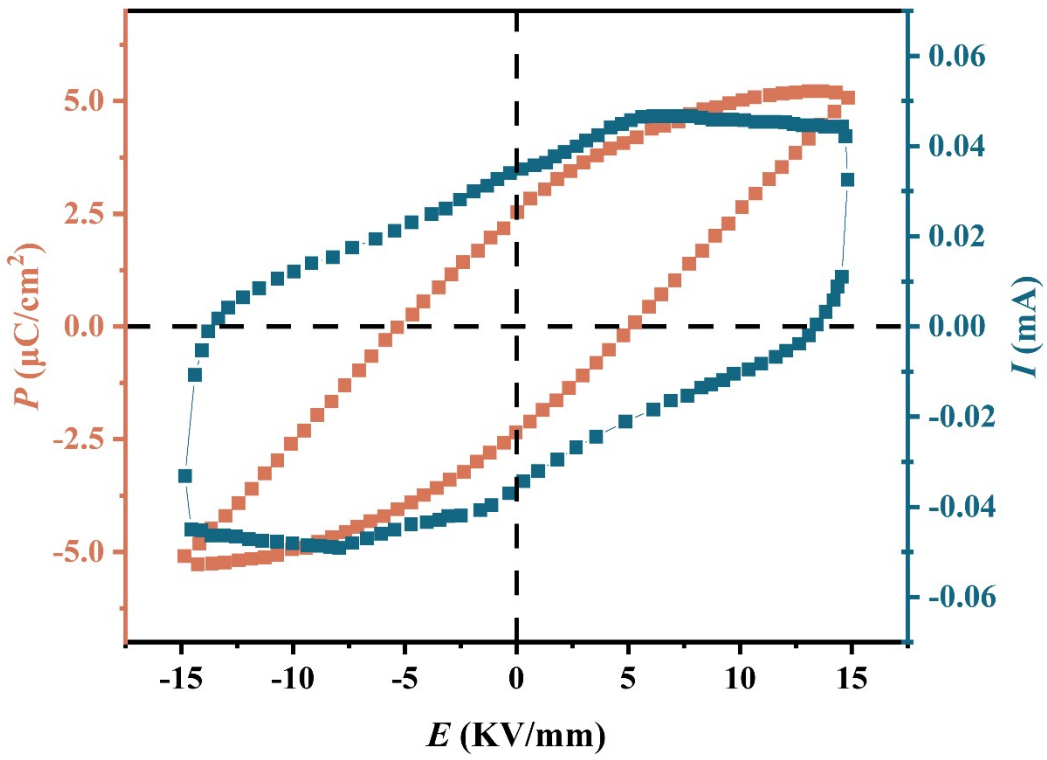

Fig. S3 P – E and I – E hysteresis loops of SNVM6.

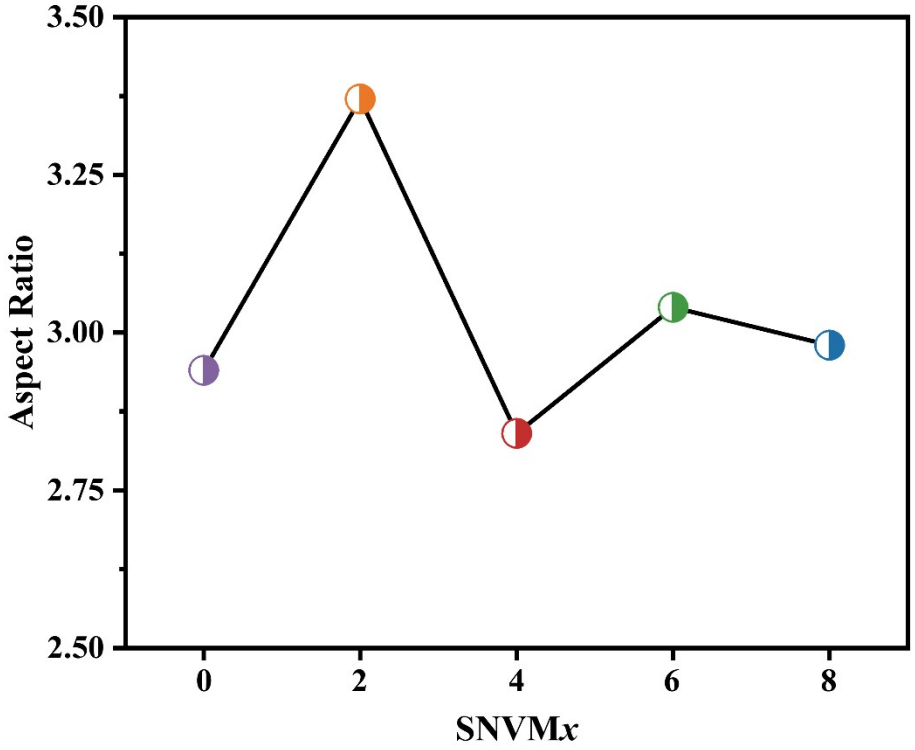

Fig. S4 The grain aspect ratios of SNVM*x* ceramics.

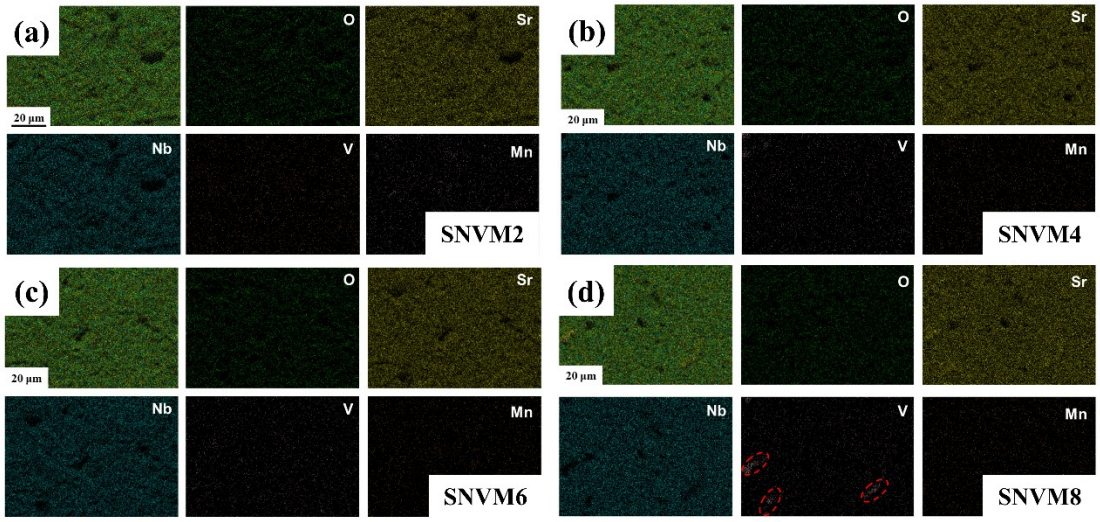

Fig. S5 Elemental mappings of SNVM*x* ceramics.

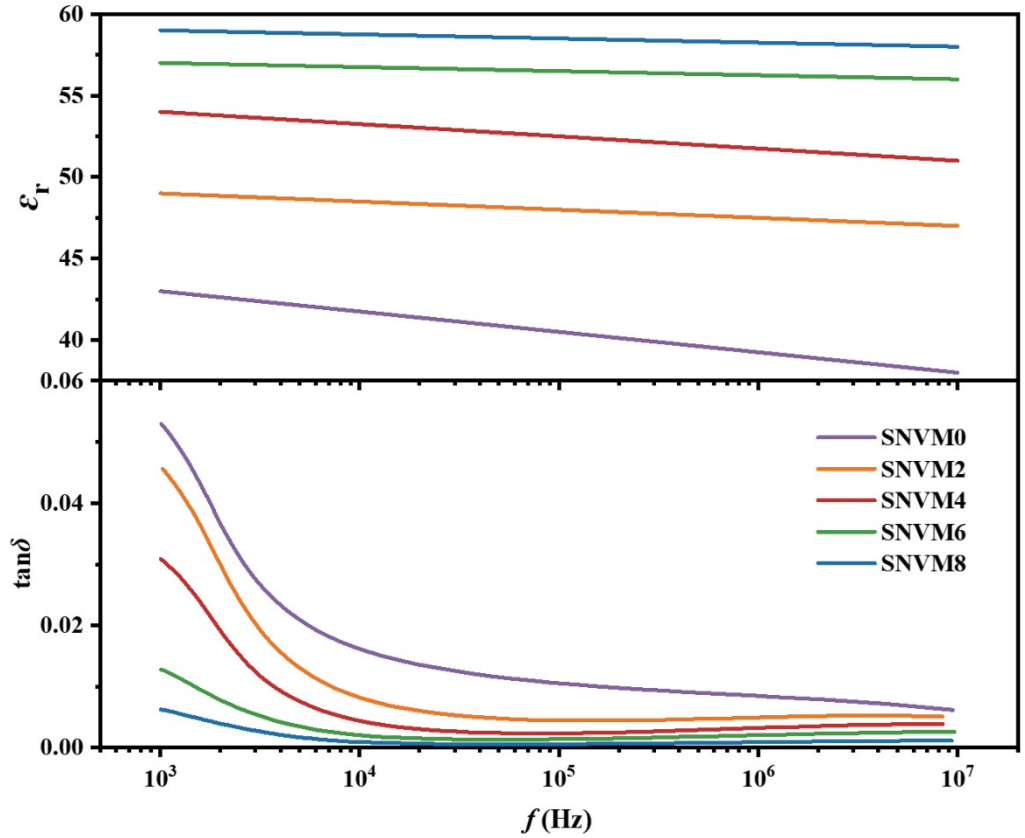

Fig. S6 Frequency dependence of dielectric constant and loss of SNVM*x*.

As shown in Fig. S4, the dielectric constant (ε_r) of SNVMx decreases only slightly over 10^3-10^7 Hz, indicating weak frequency dispersion. Meanwhile, ε_r shifts upward with increasing *x*, suggesting an enhanced effective polarization response and improved frequency stability after the V/Mn co-doping. The dielectric loss (tanδ) is relatively high at low frequencies but drops rapidly as frequency increases and remains very low at high frequencies; importantly, tanδ decreases markedly with increasing x.

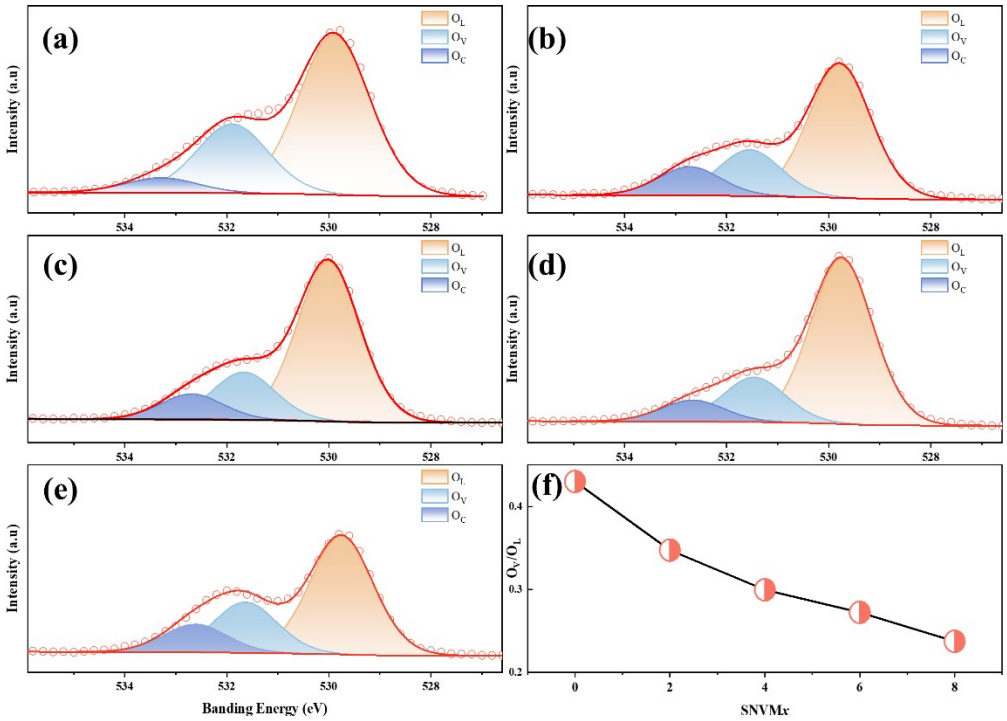

Fig. S7 The high-resolution XPS spectra of O1s for (a) SNVM0, (b) SNVM2, (c) SNVM4, (d) SNVM6, (e) SNVM8 ceramics and (e) Oxygen vacancy content of SNVM*x* ceramics.

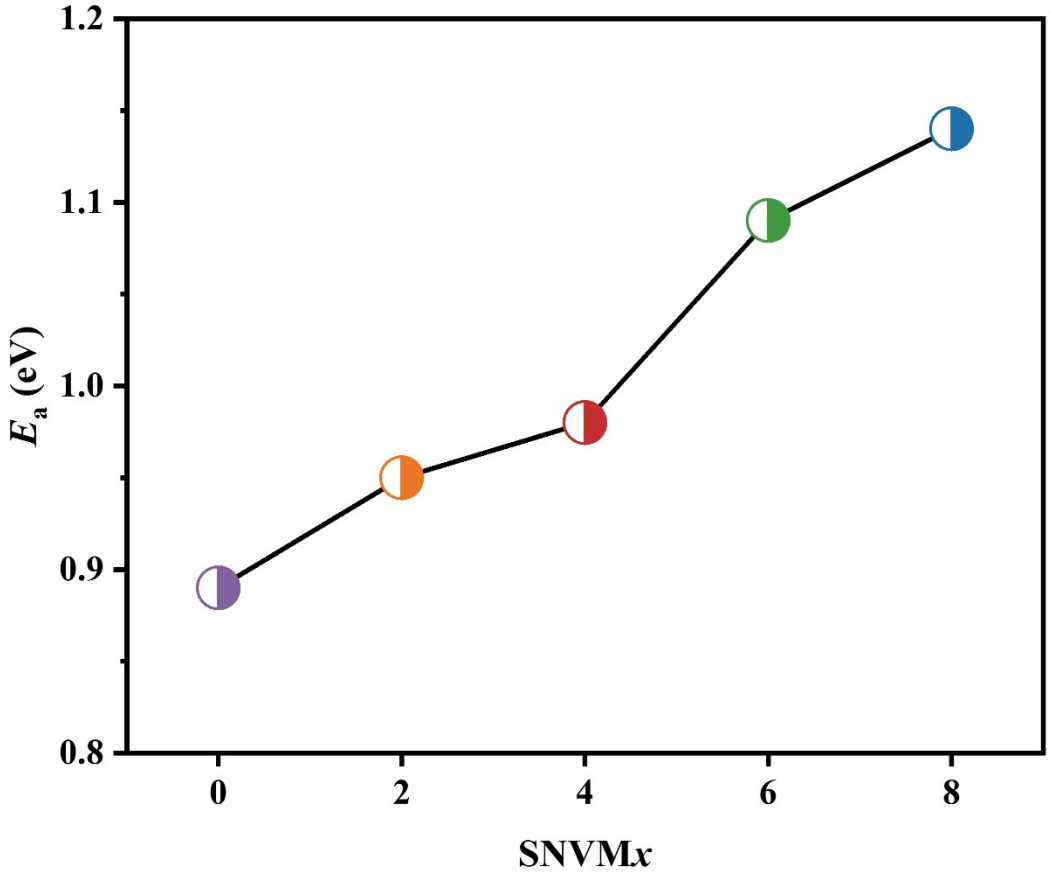

Fig. S8 Calculated *E*a values for SNVM*x* ceramics.