SUPPORTING INFO

Table S1 summarizes both symmetry and nature (first and second order), of the Raman modes of the $BaTiO_3$-based system. According to the nuclear site group analysis, Raman active phonons of the tetragonal *P*4*mm* (C_{4v}^1) crystal symmetry are represented by $3A_1 + B_1 + 4E$. Long-range electrostatic forces induce the splitting of transverse and longitudinal phonons, which results in split Raman active phonons represented by $3[A_1 (TO) + A_1 (LO)] + B_1 + 4[E (TO) + E (LO)]$.

Supplementary Table 1. Raman modes and their mode symmetry assignments in tetragonal $BaTiO_3$-based system**.**

Raman Shift (cm^{-1})	**Symmetry**	**Abbreviated** number	**Reference**
36	E(TO)	**1**	1-5
170	A_1(TO)		2-7
180	E(TO_2), E(LO)		1-5
185	A_1(LO)		2-7
210-270	A_1(TO_2)	**2**	2-7
305	E(TO_3 + LO_2)	**3**	1-5
305	B_1		1-5
463	E(LO_3)	**4**	1-5
475	A_1(LO_2)		2-7
486	E(TO_4)		1-5
518	E(TO_5)	**5**	1-5
520	A_1(TO_3)		2-7
715	E(LO_4)	**6**	1-5
720	A_1(LO_3)		2-7

SUPPLEMENTARY MATERIAL REFERENCES

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