Supporting Information for

# $Ti^{3+}$ Self-Doping in $BaTiO_3$ Ceramic for Multi-Sensor Applications: Reduced Bandgap with Maintained Ferroelectric Properties

Chen Xi Li[ab], Xiang Li[ab], Xin Yi Chen[b], Chen Chen[c], Lei Zhao[a]* and Nan Ma[b]*

[a] *Key Laboratory of High-precision Computation and Application of Quantum Field Theory of Hebei Province, College Physics Science and Technology, Hebei University, Baoding, 071002, China*

*E-mail: leizhao@hbu.edu.cn*

[b] *CAS Key Laboratory of Inorganic Functional Materials and Devices, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, 201899, China. E-mail: manan@mail.sic.ac.cn*

[c] *State Key Laboratory of High Performance Ceramics and Superfine Microstructure, Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, 201899, China*

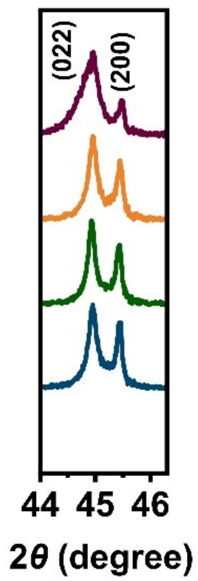


Figure S1 Enlarged XRD patterns around 45°.

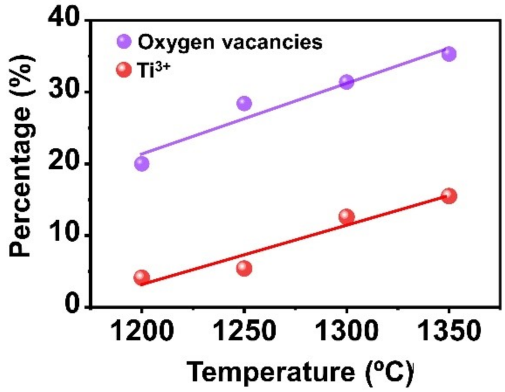


Figure S2 Sintering temperature dependence of the concentration of oxygen vacancies and $Ti^{3+}$.

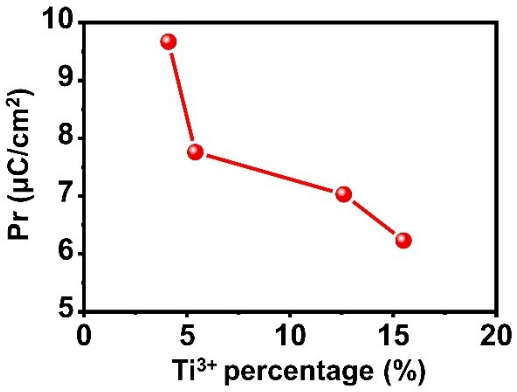


Figure S3 Change of $P_r$ as a function of the amount of $Ti^{3+}$.

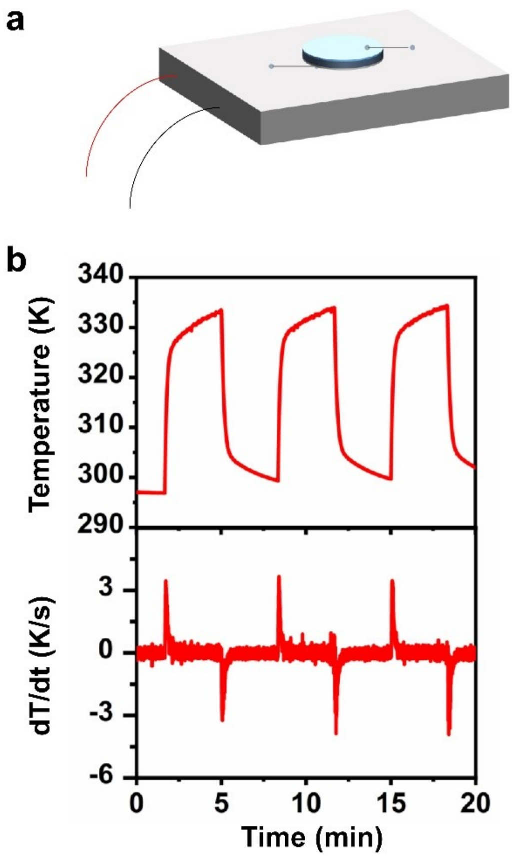


Figure S4 (a) Schematic illustration of the pyroelectric current measurement; (b) The periodic temperature change and the corresponding temperature change rate.

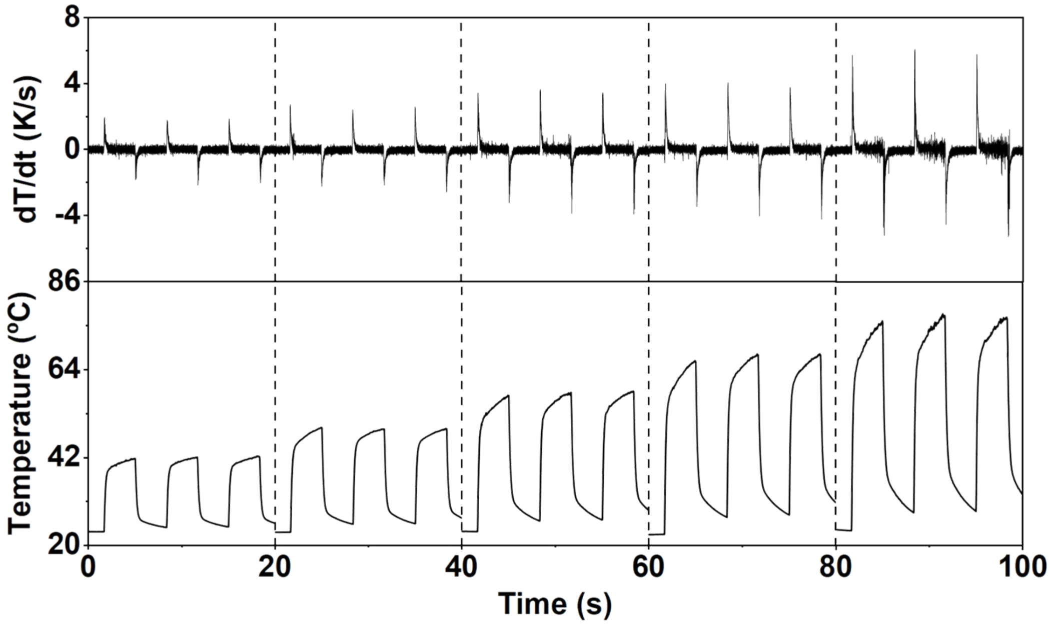


Figure S5 Temperature change and the corresponding change rates.

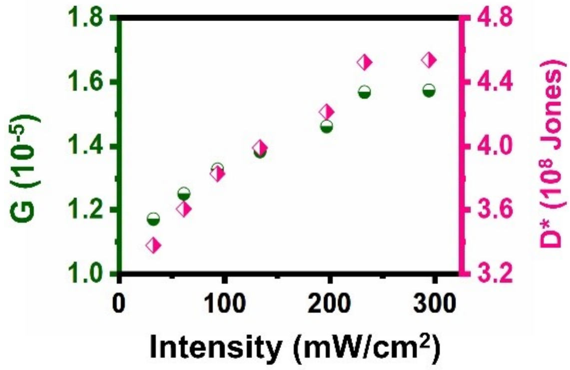


Figure S6 Light intensity-dependent of photoconductive gain *G* and specific detectivity *D**.

**Table S1 Binding energy of different temperature-sintered BTO samples.**

| | $O_L$ | $O_V$ | $O_{ads}$ | $Ti^{3+}$ 2p3/2 | $Ti^{3+}$ 2p1/2 | $Ti^{4+}$ 2p3/2 | $Ti^{4+}$ 2p1/2 |
|---|---|---|---|---|---|---|---|
| **1200 ºC** | 529.0 | 530.8 | 531.8 | 457.6 | 463.0 | 457.9 | 463.7 |
| **1250 ºC** | 529.1 | 530.9 | 532.0 | 457.7 | 463.1 | 458.0 | 463.8 |
| **1300 ºC** | 529.2 | 530.9 | 532.2 | 457.8 | 463.3 | 458.2 | 464.0 |
| **1350 ºC** | 529.2 | 531.0 | 532.4 | 457.8 | 463.5 | 458.2 | 464.0 |

**Table S2 Comparison of the Photodetection Parameters for $Ti^{3+}$-BTO Photodetector and Other Ferroelectric Materials Based Self-powered Photodetectors.**

| Photodetector | Working Mechanism | Wavelength (nm) | ***R*** (A/W) | ***D**** (Jones) |
|---|---|---|---|---|
| **[1]$BaTiO_3$** | Photovoltaic-pyroelectric | 405 | $3.25\times10^{-7}$ | $2.97\times10^{5}$ |
| **[2]$BaTiO_3$** | Photovoltaic | 405 | $3.5\times10^{-7}$ | $1.1\times10^{6}$ |
| **[3]$BiFeO_3$** | Photovoltaic-pyroelectric | 450 | $2.4\times10^{-7}$ | $8.5\times10^{8}$ |
| **[4]$Bi_{0.5}Na_{0.5}TiO_3$** | Ferro-pyro-phototronic | 405 | $4.06\times10^{-6}$ | $1.27\times10^{7}$ |
| **[5]PLZTN9** | Ferroelectric photovoltaic | AM 1.5G | $3.67\times10^{-7}$ | $9.08\times10^{7}$ |
| **[6]BZT-BCT** | Photovoltaic-pyroelectric | 405 | $8.48\times10^{-7}$ | $2.37\times10^{6}$ |
| **[7]PLZT** | FE polarization and Schottky barrier | 340 | $1.12\times10^{-5}$ | $4.43\times10^{8}$ |
| **$Ti^{3+}$ Self-doped $BaTiO_3$ (This work)** | FE polarization and Schottky barrier | 405 | $5.14\times10^{-6}$ | $4.54\times10^{8}$ |

## References for Supporting Information


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