

Supplementary

XRD

The in-situ XRD data were recorded by Shimadzu XRD-7000 using Cu K α X-ray radiation ($\lambda=0.154\text{nm}$) with $\theta-2\theta$ diffraction geometry. In order to avoid the local stress due to intergranular interaction of the bulk sample, the ceramic specimen for XRD measurement was ground into fine-sized powder.¹

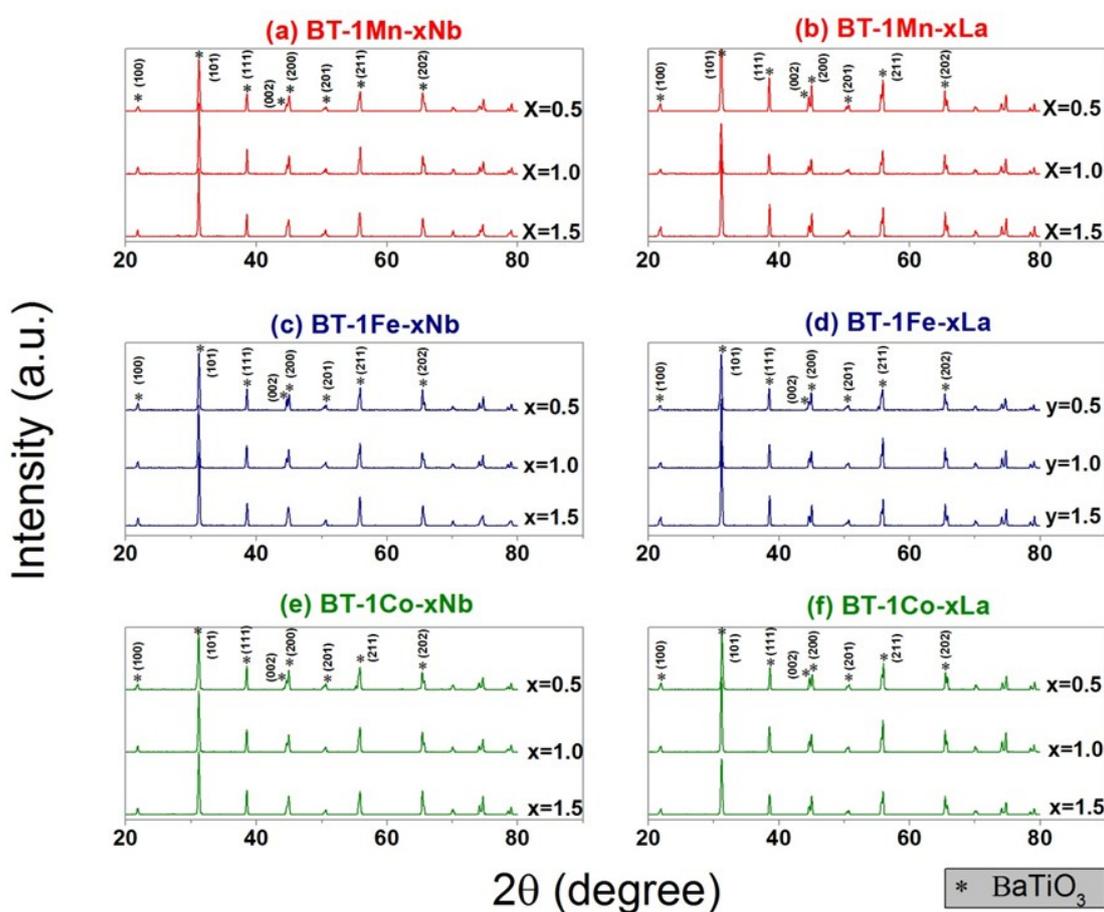


Fig. 1 X-ray diffraction patterns of (a) BT-1Mn-xNb, (b) BT-1Mn-xLa, (c) BT-1Fe-xNb, (d) BT-1Fe-xLa, (e) BT-1Co-xNb and (f) BT-1Co-xLa.

SEM

SEM micrographs of the fractured surface of specimens were taken by scanning electron microscope JSM-7000F. The SEM images are shown in Fig. 2-4 for different acceptor/donor ratio cases respectively.

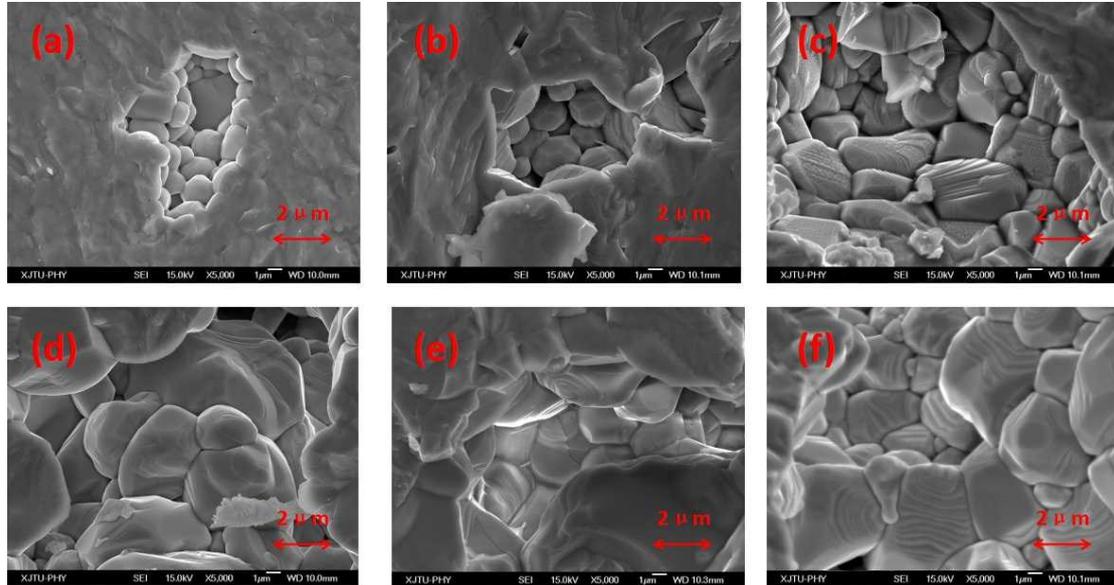


Fig. 2 SEM images of acceptor-dominant hybrid-doped BaTiO_3 samples. (a) BT-1Mn-0.5Nb, (b) BT-1Fe-0.5Nb, (c) BT-1Co-0.5Nb, (d) BT-1Mn-0.5La, (e) BT-1Fe-0.5La, (d)BT-1Co-0.5La.

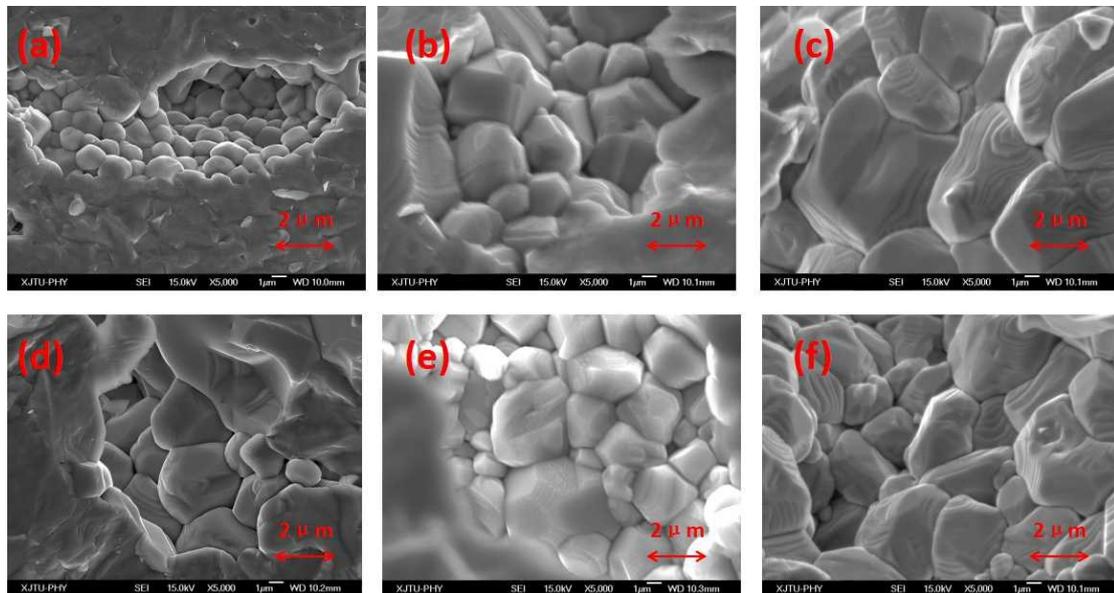


Fig. 3 SEM images of equal-doped hybrid-doped BaTiO_3 samples. (a) BT-1Mn-1Nb, (b) BT-1Fe-1Nb, (c) BT-1Co-1Nb, (d) BT-1Mn-1La, (e) BT-1Fe-1La, (d) BT-1Co-1La.

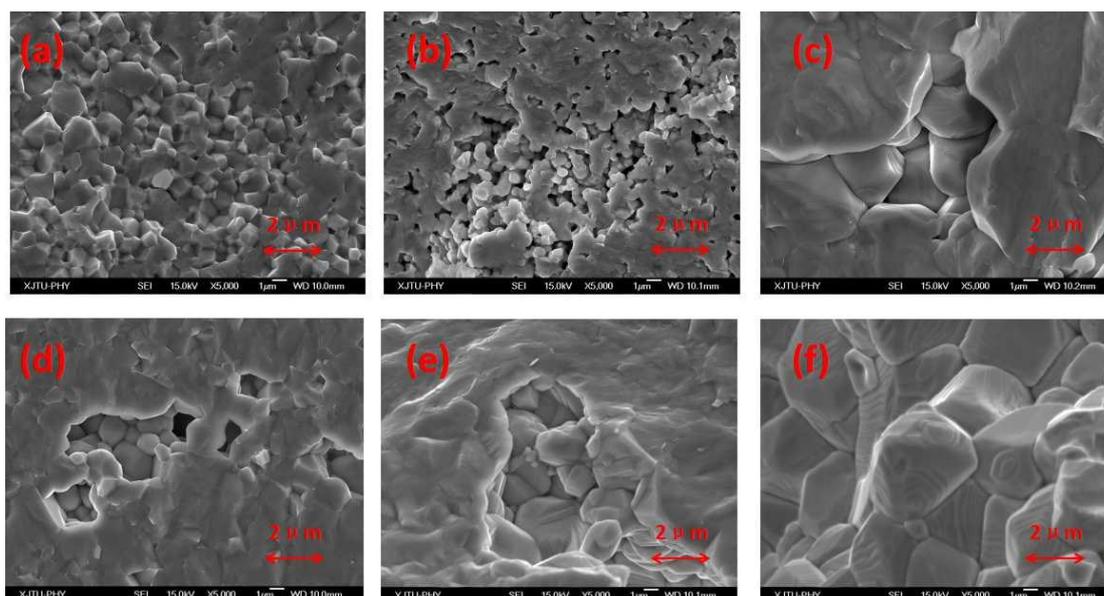


Fig. 4 SEM images of donor-dominant hybrid-doped BaTiO₃ samples. (a) BT-1Mn-1.5Nb, (b) BT-1Fe-1.5Nb, (c) BT-1Co-1.5Nb, (d) BT-1Mn-1.5La, (e) BT-1Fe-1.5La, (d)BT-1Co-1.5La.

The homogeneous and completely fine-grained microstructure with grain size ranged from 1.0-4.0 μ m, without any indication of abnormal grains.

Reference

1. J. Gao, S. Ren, L. Zhang, Y. Hao, M. Fang, M. Zhang, Y. Dai, X. Hu, D. Wang and L. Zhong, Applied Physics Letters, 2015, 107, 113.