

## Supplementary Information

### **Effective doping control in Sm-doped BiFeO<sub>3</sub> thin films via deposition temperature**

Han Wang<sup>1\*</sup>, Jijie Huang<sup>1</sup>, Xing Sun<sup>1</sup>, Jie Jian<sup>1</sup>, Juncheng Liu<sup>1</sup> and Haiyan Wang<sup>1,2\*</sup>

<sup>1</sup>School of Materials Engineering, Purdue University, West Lafayette, IN 47907, USA.

<sup>2</sup>School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN 47907, USA.

\*corresponding author: Han Wang: han.wang@pnnl.gov

Haiyan Wang: hwang00@purdue.edu

Table S1 Comparison of rear-earth doped BFO and BFO thin films prepared by PLD

System	Deposition temperature(°C)	Remnant Polarization( $\mu\text{C}/\text{cm}^2$ )	References	The number in brackets is the sequence in manuscript.
$\text{Bi}_{0.8-0.85}\text{Sm}_{0.2-0.15}\text{FeO}_3$	600	60	1(17)	
$\text{Bi}_{1-x}\text{RE}_x\text{FeO}_3$ (RE = Sm, Gd, Dy)	590	15 ~ 70	2(22)	
$\text{Bi}_{1-x}\text{Nd}_x\text{FeO}_3$ ( $x=0.00, 0.05, 0.10$ and $0.15$ )	600	----	3	
$\text{Bi}_{1-x}\text{Eu}_x\text{FeO}_3$ ( $x = 0, 0.03, 0.05, 0.07, 0.1$ )	700	----	4, 5(30)	
$\text{Bi}_{0.9}\text{Gd}_{0.1}\text{FeO}_3$	550	40	6	
Tb-doped $\text{BiFeO}_3$ ( $\text{Bi}_{1-x}\text{Tb}_x\text{FeO}_3, 0 \leq x \leq 0.15$ )	520	25 ~ 80	7	
Yb-doped $\text{BiFeO}_3$ ( $\text{Bi}_{0.85}\text{Yb}_{0.15}\text{FeO}_3, \text{YBFO}$ )	850	41.5	8	
$\text{BiFeO}_3$	650 ~ 700	50	9(26)	
$\text{BiFeO}_3$	670	----	10(27)	
$\text{Bi}_{0.85}\text{Sm}_{0.15}\text{FeO}_3$	670	17	This work	

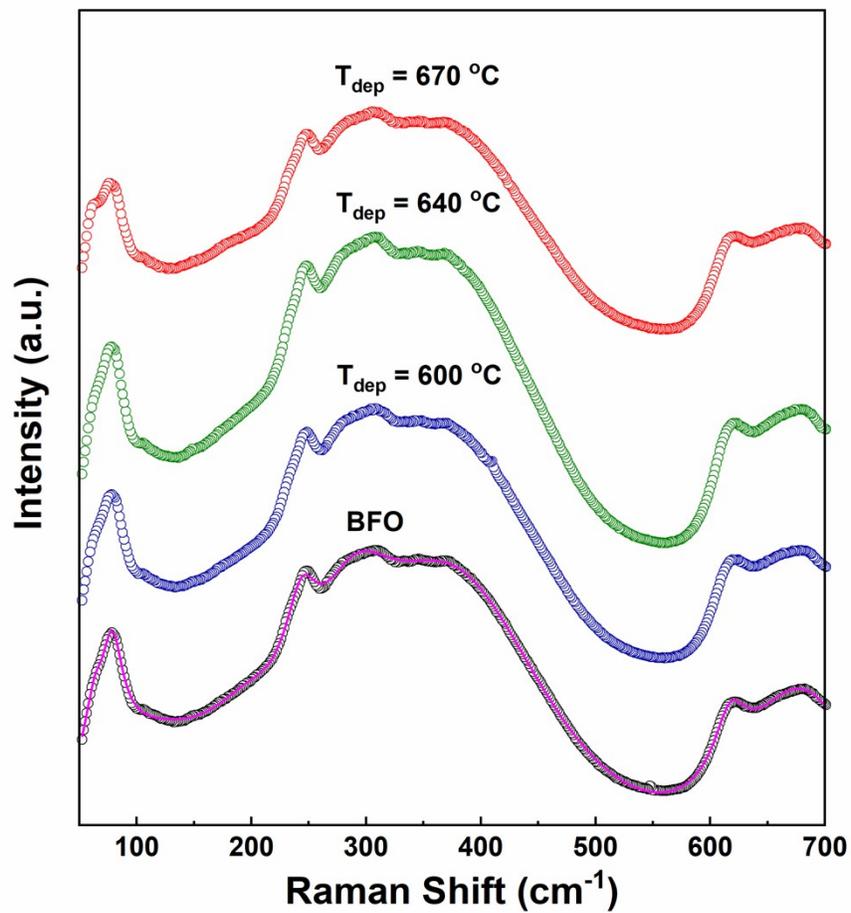
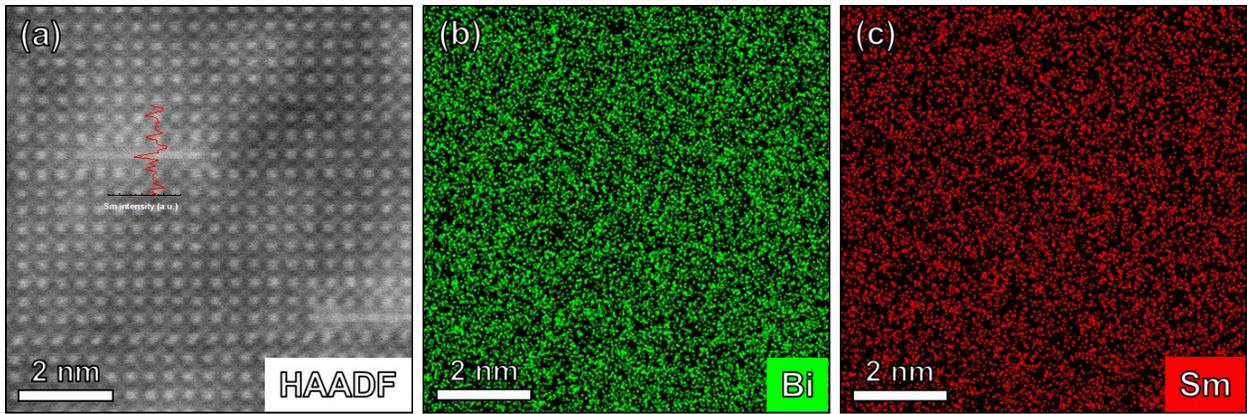


Fig. S1. Raman spectra for BSFO and BFO films.



**Fig. S2.** HAADF image (a) with EDS mapping of Bi (b) and Sm (c) for BSFO thin film. The overlays in (a) shows the EDS line-scan profiles of Sm across the white line.

## References:

1. S. Fujino, M. Murakami, V. Anbusathaiah, S.-H. Lim, V. Nagarajan, C. Fennie, M. Wuttig, L. Salamanca-Riba and I. Takeuchi, *Applied Physics Letters*, 2008, **92**, 202904.
2. D. Kan, L. Pálová, V. Anbusathaiah, C. J. Cheng, S. Fujino, V. Nagarajan, K. M. Rabe and I. Takeuchi, *Advanced Functional Materials*, 2010, **20**, 1108-1115.
3. A. Gaur, P. Singh, N. Choudhary, D. Kumar, M. Shariq, K. Singh, N. Kaur and D. Kaur, *Physica B: Condensed Matter*, 2011, **406**, 1877-1882.
4. J. Liu, H. Deng, H. Cao, X. Zhai, J. Tao, L. Sun, P. Yang and J. Chu, *Applied surface science*, 2014, **307**, 543-547.
5. J. Liu, H. Deng, X. Zhai, H. Cao, P. Yang and J. Chu, *Journal of Materials Science: Materials in Electronics*, 2015, **26**, 2977-2981.
6. Z. Cheng, X. Wang, S. Dou, H. Kimura and K. Ozawa, *Journal*, 2008.
7. M. Yi, C. Wang, L. Li, J. Wang, Q. Shen and L. Zhang, *Applied Surface Science*, 2015, **344**, 47-51.
8. Y. Ahn and J. Y. Son, *Physica B: Condensed Matter*, 2019, **558**, 24-27.
9. Z.-Z. Jiang, Z. Guan, N. Yang, P.-H. Xiang, R.-J. Qi, R. Huang, P.-X. Yang, N. Zhong and C.-G. Duan, *Materials Characterization*, 2017, **131**, 217-223.
10. C. Daumont, S. Farokhipoor, A. Ferri, J. Wojdeł, J. Íñiguez, B. Kooi and B. Noheda, *Physical Review B*, 2010, **81**, 144115.