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*Supplementary Materials*

# Humidity Effects on Domain Structure and Polarization Switching of $Pb(Zn_{1/3}Nb_{2/3})O_3$-x%$PbTiO_3$ (PZN-x%PT) Single Crystals

**Hongli Wang [1,2] and Kaiyang Zeng [3,*]**

[1] The Key Lab of Guangdong for Modern Surface Engineering Technology, National Engineering Laboratory for Modern Materials Surface Engineering Technology, Institute of New Materials, Guangdong Academy of Sciences, Guangzhou 510650, China; wanghongli@gdinm.com
[2] Guangdong Provincial Key Laboratory of Advanced Energy Storage Materials, School of Materials Science and Engineering, South China University of Technology, Guangzhou 510640, China
[3] Department of Mechanical Engineering, National University of Singapore, 9 Engineering Drive 1, Singapore 117576, Singapore
* Correspondence: mpezk@nus.edu.sg; Tel: (+65)-6516-6627; Fax: (+65)-6779-1459

In our experiment, a commercial Humidity Sensing Cell (Asylum Research, Oxford Instruments, Santa Barbara, CA, USA) was used to detect the real-time humidity. As shown in Figure S1, there are four holes in edge of the closed cell, 1 and 2 for dry and wet gas in, 3 and 4 are for gas out. The humidity can be controlled by dynamically filling the closed cell with different ratios of wet and dry gases.

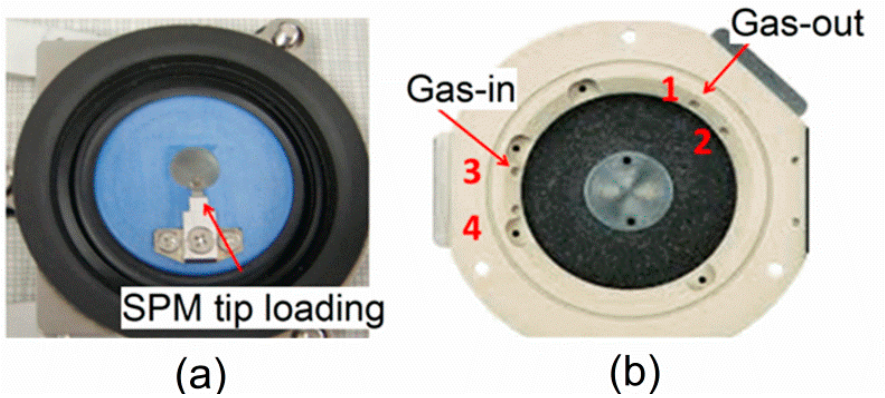


**Figure S1.** Images of the closed electrical cell: (**a**) the top part; and (**b**) the bottom part.

As shown in Figure S2, the ratio of dry and wet synthetic air can be controlled by flowmeter 1 and flowmeter 2. By adjusting the flow rate, the relative humidity manipulation can be achieved. At the same time, an environmental controlling cell with a humidity sensor is employed to detect the real-time relative humidity during the SPM measurements.

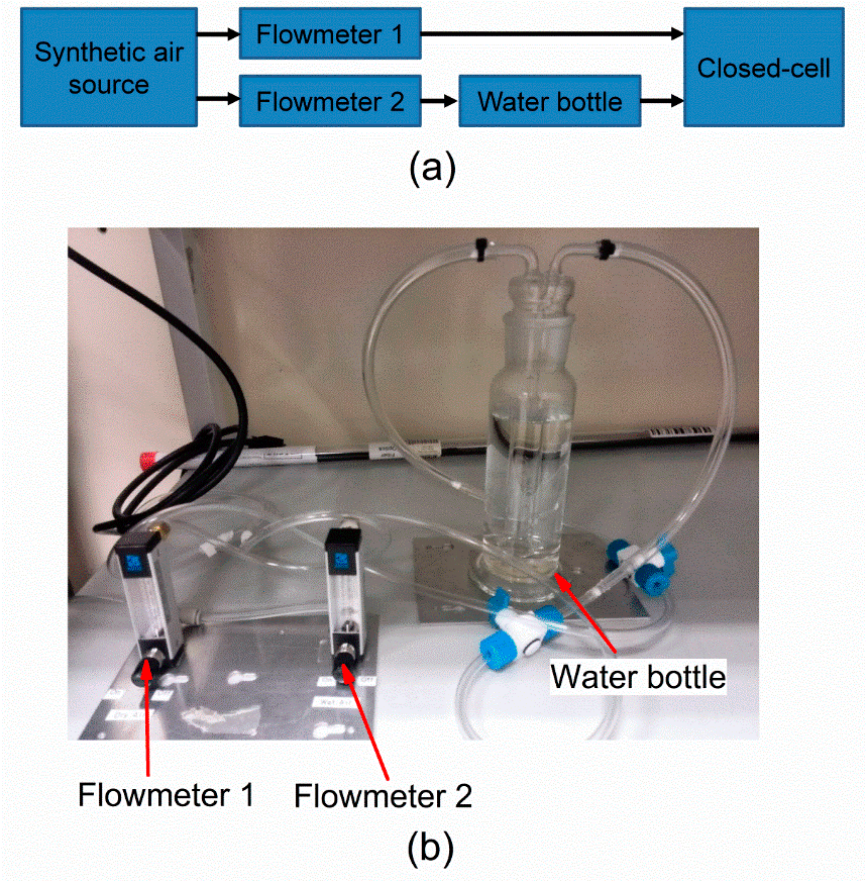


**Figure S2.** (**a**) schematic of humidity control system; and (**b**) image of the humidity control system used in this study.