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Study of Pt/SrTiO3 under humid environment with Ambinet Pressure-XPS

Content

Utilizing Pt electrode on SrTiO3 (STO) surface has been widely investigated in the resistive switching memory devices. Generally, the interfacial properties of high work function metal electrode (Pt) and STO are known to control the magnitude/form of resistive switching hysteresis. Then, in recent report, the relative humidity can also contribute the resistive switching properties of Pt/STO, i.e., I-V characteristics and variation of Schottky barrier height, by compensating oxygen vacancies in STO substrate with electrical source. [1] To understand the unique behavior under environmental humidity, the understanding of redox reaction mechanism at the Pt/STO interface is crucial. Especially, the modified electronic structure at the interface can be highly important.

To monitor the influence of environmental humidity on interfacial electronic structure of the system, an ambient pressure x-ray photoelectron spectroscopy (AP-XPS) was utilized at elevated temperature under H2O pressure of 1 mbar. Two samples are prepared, one with bare SrO-terminated STO surface (S-STO) and the other with Pt-deposited S-STO surface. In our previous work, SrO layer was formed reproducibly on the STO surface with upward band bending by oxygen annealing process. [2] In the case of S-STO surface, no changes are found under elevated temperature from 250 ℃ to 600 ℃. On the other hand, for the case of Pt/S-STO surface, all core level spectra are shifted towards the lower binding energy direction, ~0.7 eV from 250 ℃ to 600 ℃, indicating the additional band bending. Our results suggest that the observed surface band bending from Pt/S-STO is reflecting the modified electronic structures at the interfacial layer due to the humid environment.

[1] Sediva, Eva, et al. Advanced Electronic Materials 5, 1800566 (2019)
[2] Lim, Hojoon, et al. Journal of Materials Chemistry C 9, 13094 (2021)

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