# Investigation of local contact potential difference and local dipole moment on $TiO_2$(110) surface by SCM

**Department of applied physics, Osaka University**

**°Huanfei Wen, Masahide Suesada, Yanjun Li and Yasuhiro Sugawara**

**E-mail: hfwen@ap.eng.osaka-u.ac.jp**

Au/rutile $TiO_2$(110) surfaces display extremely high catalytic reactivity and have been model to investigate the mechanism of the CO oxidation reaction [1]. Excess electrons produced by the formation of defects significantly play an important role for the adsorption of Au nanoclusters and catalytic reaction process. However, the injection/extraction mechanism of electrons and the reaction process are not clarified by a comprehensive experimental description. Furthermore, the local contact potential difference (LCPD) with atomic resolution hasn't been obtained on $TiO_2$(110) surface. Electrostatic capacitance has a one-on-one relationship to the dipole moments. Dipole moment distribution can be observed by the measurement of capacitance, and it is very useful to understand the catalytic reaction process. In this study, we simultaneously measure LCPD and differential capacitance ($\partial C(V,z)/\partial V$) with atomic resolution on $TiO_2$(110) surfaces by scanning capacitance microscopy (SCM).

In the experiment, the DC bias added with ac bias voltage was applied between the tip and the sample. Three lock-in amplifiers were used to detect frequency shift at $f_m$, $f_{2m}$ and $f_{3m}$. The CPD signals were numerically calculated from the divided result of $f_m$ and $f_{2m}$ signals [2, 3] and differential capacitance signals were from the divided result of $f_{3m}$ and $f_{2m}$ signals.

Experiments were performed with the homebuilt low temperature CFM under ultrahigh vacuum (UHV) condition. The rutile $TiO_2$(110) surface was cleaned by the cycles of Ar ion bombardment and subsequent annealing at 1000K. As a probe, the commercial Ir-coated Si cantilevers were chosen.

We used the constant height mode to obtain LCPD and differential capacitance images, and to remove the crosstalk of the surface topography by setting the proportional integration (PI) controller to zero. The z-dependent of $V_{\mathrm{LCPD}}(z)$ curves were measured. We discussed the contrast of defect's LCPD and its effect to catalytic process.

Experimental data will be reported in the meeting.

References:

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