Investigation of local surface potential induced by atomic dipole moment on TiO_2(110) surface by Kelvin Probe Force Microscopy

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Rutile titanium dioxide (TiO_2) has been widely employed as a prototype to investigate the physical and electronic properties of metal oxides. Rutile TiO_2(110) surface, with stable single-crystal facet and atomic species point defects including oxygen vacancies and hydroxyl groups, has widespread applicability in the CO oxidation reaction [1]. Recently, the surface potential of rutile TiO_2(110) surface, induced by the chemical interaction and surface dipole moment between the tip apex and surface atoms, has been measured [2], in which the latter one strongly affect the potential barrier height [3]. However, the percentage of the dipole moment induced surface potential in the total surface potential has not been investigated yet, which plays an important role in the catalytic mechanism of oxidation reaction.

In this work, by means of Kelvin Probe Force Microscopy (KPFM), we qualitatively measured the dipole moment distribution of rutile TiO_2(110) facet and investigated the percentage of the dipole moment induced surface potential in the total surface potential. Experiments were carried out under ultrahigh vacuum (UHV) condition performed at a low temperature of 77 K. And the rutile TiO_2(110) surface was cleaned by the cycles of Ar ion bombardment and subsequent annealing at 1000K. Commercial Ir-coated Si cantilever was used after being cleaned with annealing and Ar-ion sputtering. The DC bias voltage added with an 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 contact potential difference (CPD) was numerically calculated from the divided result of f_m and f_{2m} signals and the surface potential induced by dipole moment was obtained from the DC bias feedback.

The details will be reported in the meeting.

References:

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