Photoelectron Spectroscopy Study of The N-doped TiO_2(110) Surface

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This work has mainly concentrated on the study of the reaction of TiO_2 with NH_3 gas and the function of annealing temperature in flowing Ar gas. The analysing depth of X-ray photoelectron spectroscopy (XPS) depends on the inelastic mean free path (IMFP) of a photoelectron. Since the IMFP of a photoelectron is a function of its kinetic energy, the analysing depth of XPS changes with the excitation energy. We apply this relationship to the depth profile analysis of Photoelectron Spectroscopy measurement by using energy tuneable synchrotron radiation .

The resonant behaviour of N-doped TiO_2 (110) surfaces have been investigated using synchrotron photoemission spectroscopy (PF BL-3B). The data are compared with Photoelectron spectra (hν= 600eV, FWHM : 170meV, PF BL-13A) work in order to elucidate the depth of the valence band region.

The spectra are clearly different from each others. The 30-60eV peaks at around 8eV at the bottom the valence bond is absent and photoemission intensity extends from the original position of the valence band edge all the way to the Fermi level. The 600eV spectrum has a distinct peak that appears close to the Fermi energy. We can speculate this is associated with Ti^{3+} $3d^1$ states and signals the onset of surface reduction of the TiO_2 crystal . The hν=60eV is clearly seen to undergo a resonance within the band-gap state, at 0.6eV . A similar effect was also seen for the defect state or O-vacancy state. The resonance observed here suggests a contribution from Ti 3d to this state presumably as a result of surface O vacancies.

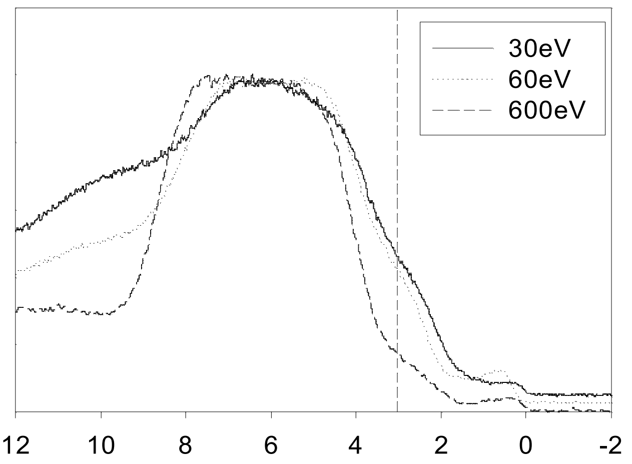

Figure1 Valence band region spectra of NH_3 treatment rutile TiO_2 single crystal

References

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