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One-photon and two-photon photoemission studies on hydrogenated TiO2 surfaces

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Titanium dioxide (TiO2) surfaces are of importance and interest in various aspects including photocatalytic H2 generation and hydrogen sensors. Furthermore, hydrogen-doped TiO2 has recently acquired much attention due to its excellent photocatalytic activity [1]. In these regards, interaction of hydrogen with TiO2 surfaces is of particular importance. In our previous study, we have investigated the interaction of hydrogen with the rutile TiO2(110) surface with nuclear reaction analysis and ultraviolet photoemission [2]. The electronic excited state was, on the other hand, studied with two-photon photoemission on clean TiO2(110) [3]. In the present paper, we report one-photon and two-photon photoemission results on hydrogenated TiO2(110).
The sample was prepared by exposing clean TiO2(110) to either atomic hydrogen or a hydrogen ion beam, and one-photon and two-photon photoemission spectra were measured with the HeI source and laser light at 3.35-3.85 eV, respectively. Whereas an in-gap state was observed at about 1 eV below the Fermi level after atomic hydrogen dosage, the in-gap state intensity was considerably enhanced after hydrogen ion irradiation. The two-photon photoemission spectra revealed a feature at about 6.5 eV above the Fermi level, which is similar to the one observed on the clean surface [3]. The intensity of the feature was also found to be dependent on the polarization. The electronic structures of the hydrogen-adsorbed and hydrogen-ion-irradiated surfaces are discussed.

References
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Primary author: Prof. FUKUTANI, K. (University of Tokyo)

Co-authors: Ms OHASHI, Y. (University of Tokyo); Dr NAGATSUKA, N. (University of Tokyo); Dr SAKURAI, A. (University of Tokyo); Dr OGURA, S. (University of Tokyo); Prof. ASHIHARA, S. (University of Tokyo)

Presenter: Prof. FUKUTANI, K. (University of Tokyo)

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