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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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