

Abstract Submitted
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Coupling Reactions of Formaldehyde on Rutile TiO₂(110) ZHEN-RONG ZHANG, KE ZHU, YAOBIAO XIA, Baylor University, Waco, TX 76798, MIRU TANG, Southern Illinois University, Carbondale, Illinois 62901, ZHI-TAO WANG, IGOR LYUBINETSKY, Pacific Northwest National Laboratory, Richland, Washington 99352, GINGFENG GE, Southern Illinois University, Carbondale, Illinois 62901, ZDENEK DOHNALEK, Pacific Northwest National Laboratory, Richland, Washington 99352, KENNETH PARK, Baylor University, Waco, TX 76798 — We have studied reactions of formaldehyde on reduced rutile TiO₂(110) surfaces using scanning tunneling microscope (STM). Images from the same area at viable temperatures (75 – 170 K) show two coupling reactions channels. Formaldehyde adsorbed on bridging-bonded oxygen vacancy (V_O) couples with Ti-bound CH₂O form a diolate species, which stays stable at room temperature. Consequently, exposure of formaldehyde at room temperature leads to diolate as the majority species on the surface and no V_O-bound formaldehyde is observed. STM images directly visualize a second coupling reaction channel, a low-temperature channel. Two V_O-bound formaldehyde molecules can couple and form Ti-bound species, which desorbs above 215 K. This coupling reaction heals both the V_O sites indicating formation and desorption of ethylene. Statistical analysis shows that the total visible reaction products observed on the surfaces can only account for a half of the consumption of the initial V_O coverage, which further supports the desorption of the coupling reaction product, ethylene, after formaldehyde exposures between 215 and 300 K.

Zhenrong Zhang
Baylor University, Waco, TX 76798

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