Anisotropic Etching of TiO_2(110) Single-Crystal Surface with Aniline Solution Immersion for Step Direction Control

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TiO_2(110) single-crystal surface have been used as a model surface for photocatalytic reactions. It is important to control of a step direction on TiO_2(110) surface because photocatalytic reactions depend on the step direction. However, there are few reports to control. In this study, we found TiO_2(110) surface was etched and a uniform step structure in the [001] direction formed after immersing of the clean TiO_2(110) single-crystal substrate in an ethanol solution containing aniline.

It is known that AN is uniformly adsorbed on the TiO_2(110) surface when it was vacuum deposited. However, AN was not adsorbed on the TiO_2(110) surface from the solution. Nevertheless, its surface morphology was significantly different before and after the immersion into the ethanol solution containing AN (Fig. 1). Zigzag steps in the $[\bar{1}12]$ direction with many kinks were observed in the sample prepared by immersion into the solution without AN (sample Et), whereas linear $[001]$ direction steps were observed when the sample was immersed in the solution containing AN (sample AN). Since Ti was detected in the solution after immersion, it was concluded that the etching was promoted by the formation of TiO_2-AN complex and its desorption as a result of adsorption of AN to step edged Ti.

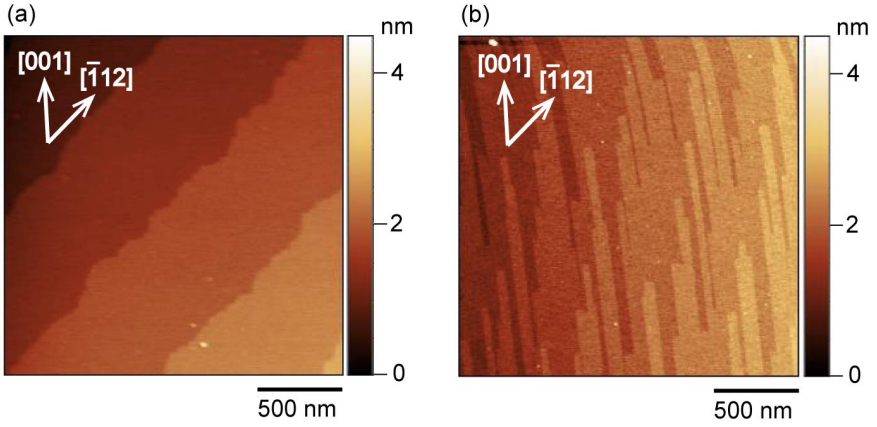

Figure 1 AFM images of (a) sample Et and (b) sample AN (2 μm × 2 μm) [1)].

1) M. Takahari, T. Goto, S. Yoshimoto, T. Kondo, *Chem. Lett.* **2023**, *52*, 823.