Electrochemical Etching of Si(111) Surfaces in Dilute Fluoride Solutions

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A large number of works have been performed to understand chemical and electrochemical etching reactions of Si(111) surfaces in the fluoride solutions.[1-4] Recently most research with Si(111) etchings has tended to be focused on the reactions in concentrated fluoride solutions (40% NH_4F) because of the good quality of the Si(111)-H surfaces obtained in 40 % NH_4F.[3,4] However, in order to study the details of electrochemical etching reactions of Si(111) surfaces, the sophisticated observation during slow etching of Si(111) surfaces in the dilute fluoride solutions is needed.

In this report, we would like to present the results of the surface morphological changes during electrochemical etching of Si(111) oxide in the dilute fluoride solutions by means of the electrochemical scanning tunneling microscopy. Figure 1 shows EC-STM images (500 x 500 nm) of Si(111)-H surface in 0.1 M H_2SO_4 after treatment of an oxidized Si(111) surface in 40 % NH_4F solution. The typical features of this surface are perfect monohydrogen terminated terraces with 3.1 □ bilayer steps which agree well with the data reported in the literatures.[3-4]

On the other hand, the etching of the Si(111) at anodic potential in dilute fluoride solution produced the surface with a large number of triangular and deep pits like Figure 2.

These results conclude that the applied potential as well as pH of the solutions play an important role in the electrochemical etching of Si(111) surfaces. We will present the dependences of the applied potential and pH of the solutions in the electrochemical etching of Si(111) surfaces.

References

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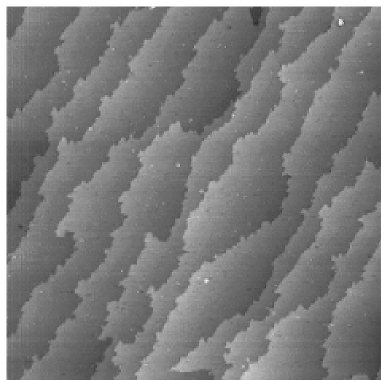

Figure 1. EC-STM images(500 x 500 nm) of Si(111) surface in 0.1 M H_2SO_4 after chemical etching in 40 % NH_4F solution.

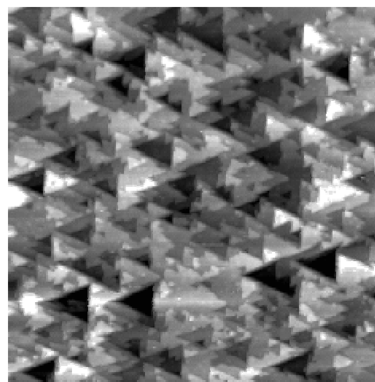

Figure 2. EC-STM images(500 x 500 nm) of Si(111) surface in 0.1 M H_2SO_4 after electrochemical etching in 0.1 M NH_4F solution(pH 5.2) at +0.5 **V** for 700 s.