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The Structure of Au/Si(001) System ; room temperature.

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I. Introduction

The adsorption of metals on silicon surface was subject of several investigations in the past, because of the physical interest in metal-semiconductor interfaces and the importance for the technical applications. However, most of them concern (111) silicon : although of greater practical importance much less attention has been paid to (100) surface. Especially, the structure of gold on Si(001) at low coverage is not clear.

CAICISS is a powerful technique for analyzing the three dimensional atomic structure of the films on the substrate. In this study, we investigate the atomic structure of Au on Si(001) substrate at low coverage.

II. Experimental

The experiments were performed in a ultra high vacuum chamber having a base pressure of 2×10^{-10} Torr. The Si(001) samples were chemically cleaned and immediately introduced into the chamber, and then outgassed at 800℃ at a pressure of lower than 5×10^{-9} Torr for a few hours. After outgassing, they were

heated to 1170℃ for a few seconds to remove the oxide and cooled down slowly to the room temperature. Au was evaporated onto Si(001) substrate at the room temperature, and Au coverage was measured by inferring the intensity of the back scattered He particles from the substrate. CAICISS experiment was performed as a function of incident and azimuthal angle.

III. Result and Discussion

From the polar scan curve of Au intensity, we can find the dominent Au atom spacings along [110] azimuth, the dominent Au atom spacing in 2.88 Å, and along the [100] azimuth, the dominent Au atom spacing is 5.43 and 2.88 Å. From the comparison of the polar scans of clean Si(001) surface and Au/Si(001), we can induce the site of Au on the Si(001) surface. And the structure of ultrathin Au film can be obtained from the variation of Au intensity as a fumction of azimuthal angle. In the incident angle of near 18°, the azimuthal scan of Au intensity shows the strong shadowing effect at 20°. It means that the structure of Au film is composed of Au atom pairs of which directions is rotated to 20° along the [110] azimuth and tilted to the surface.