In situ second-harmonic generation study of the structural transformation on Ag / Si(111)

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Structural transformations on Si(111) during Ag adsorption and desorption has been studied systematically by second-harmonic generation (SHG). Figure 1 shows the change of SH intensity during Ag deposition onto Si(111)-7×7, which has been found to be related mainly with the transformation from 7×7 to $\sqrt{3}\times\sqrt{3}$-Ag. The existence of 3×1-Ag during Ag adsorption and desorption was revealed by the $S_{\text{in}}S_{\text{out}}$ signal shown in Fig. 2 since no $S_{\text{in}}S_{\text{out}}$ signal can be generated from 7×7 and $\sqrt{3}\times\sqrt{3}$-Ag under our experimental conditions. The transformation from 7×7 to 3×1 was observed to be strongly temperature and flux dependent. At around 200 ~ 400 °C, Ag covered 7×7 directly transformed into $\sqrt{3}\times\sqrt{3}$-Ag; at higher temperatures, the transformation into 3×1-Ag occurred before the transformation into $\sqrt{3}\times\sqrt{3}$-Ag, as indicated by A in Fig. 2. The study of the strong $S_{\text{in}}S_{\text{out}}$ signal from 3×1-Ag is expected to further reveal the structural symmetry of 3×1-Ag [1].

Figure 3 shows the Ag flux dependence of the SH response from $\sqrt{3}\times\sqrt{3}$ at a sample temperature of 330 °C. For a shorter deposition time shown in Fig. 3(a), the SH signal recovered monotonically to what was observed before Ag deposition; however, for a longer deposition time shown in Figure 3(b), the recovery proceeded gradually in two steps. Ag clusters can be formed during Ag deposition because of the over-saturation of 2DAG as suggested by the conductivity measurements [2]. Then, the steps appeared in Fig. 3(b) and 3(c) may reflect the dissolution of Ag clusters in response to the decrease of 2DAG density.

References: