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STM Investigation of Ag Growth on Sb-terminated Si Surface

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Growth of Ag on Sb-terminated Si(100) and Si(111) was investigated with STM and LEED. With the variation of Sb coverage and temperature of Si substrate, we have found the condition for a flat and ordered Sb overlayer on Si surface. Sb/Si(100) shows 2x1 structure irrespective of the coverage and the temperature, which is different from Sb/Si(111) case where various surface structures exist. The length of dimer rows of Sb on Si(100) cannot exceed a few tens of angstroms because of the large lattice mismatch between Sb overlayer and Si(100) substrate. Onto the Sb-terminated Si surfaces, Ag was evaporated at room temperature and at a rate of 0.5 Å/min. STM investigation of the surfaces reveals that, on Sb/Si(100)-2x1 surface, Ag film grows in the island growth mode up to several monolayers. The Ag islands on that surface wouldn't coalesce with each other and, as a result, the surface morphology became rough. Furthermore, those Ag islands seem to be poorly ordered-and-crystallized, which is evidenced by diffuse background in LEED image. On the other hand, on Sb/Si(111) surface flat and large islands of Ag are formed from the coalescence of small islands. In addition, those Ag islands on Sb/Si(111) exhibit good crystallinity. These differences in the growth behavior and the crystallinity of Ag films can be explained with the effect of substrate on the initial stage of film growth. At any rate, the density of Ag islands on Sb-passivated Si surface is higher than that on clean Si surface. The size of Ag islands on Sb/Si, when one or two monolayers of Ag are deposited, are in the range of a few nanometers, which is small enough to show quantum phenomena due to the charge and energy quantization.