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Growth kinetics of Au on vicinal Si(111) : Ordered island formation along 1D nano-pattern

Chang Won Yang, Yong Sam Kim, Taechul Kim, Do Young Noh

Department of Materials Science and Engineering, Gwangju Institute of Science and Technology, Gwangju 500-712

The growth of gold particles on 1D patterned Si(111) surface is examined by AFM and in-situ surface x-ray scattering experiments. Nano scale one dimensional pattern on silicon surface was fabricated by controlling the kinetics of step bunching across the 1x1 to 7×7 transition using vicinal Si(111) substrates with 4° miscut along [11-2] direction. The surface phase separates into alternatively ordered step bunching regions and flat Si(111)7×7 terraces. Upon evaporating Au on these patterned substrates, the gold atoms on the silicon aggregate due to their high mobility, and become islands along the 1-dimensional pattern. The size of gold islands is limited by the width of the 1-dimensional pattern, i.e. the distance from a step bunching region to a Si(111)7×7 terrace region. AFM images show the gold islands of real space and x-ray data provide the relations between the width of the 1-dimensional pattern and ordered gold islands as a function of the amount of Au evaporation. We suggest that the shape and size of the Au nano particles can be changed by controlling the kinetic parameters of the substrate patterning.