

Structure Change of Ni(1 ML)/Si(111) by Post-annealing Observed by Atomic Force Microscopy, Ion Scattering and Photoelectron Spectroscopy

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Abstract

Structure change of Ni(1 ML: 7.83×10^{14} atoms/cm²)/Si(111) by post-annealing was observed by reflection high energy electron diffraction, atomic force microscopy (AFM), medium energy ion scattering (MEIS) and photoelectron spectroscopy. The AFM observation showed dramatic change of the surface morphology after the Ni deposition at room temperature (RT) followed by annealing at 400, 600, 700 and 800°C for 2 min in an ultrahigh vacuum. MEIS using 70 keV He⁺ ions analyzed the depth profiles of Ni and the crystallographic structure of the Ni-composites formed by annealing. The valence band and the Si-2p and Ni-3p core level analyses using synchrotron-radiation light showed that the NiSi phase appeared by 1 ML-Ni deposition at RT and both NiSi and NiSi₂ islands were formed by annealing at 400°C. Annealing at 600 and 700°C led to growth of the B-type NiSi₂ islands with height of 4 and 6 Si-Ni-Si triple layers. After annealing at 800°C, three-fourths of the deposited Ni atoms was dissipated from the surface and the dominant surface structure was the 1×1-ring clusters accompanied by a small amount of $\sqrt{19} \times \sqrt{19}$ phase. The present analysis clearly showed the structure change of Ni (1 ML)/Si(111) by post-annealing and provided the information about the kinetics for the Ni-Si system.

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