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## **1. Highlights in 2007**

### **(i) Growth of atomically flat, ultra-thin Ag films**

Local nucleation of three-dimensional islands makes the film morphology rough in conventional growth of ultra-thin metal films of nanometer thickness. However, by a novel two-step growth with a low temperature deposition and subsequent annealing to room temperature, atomically flat and uniform Ag films of several monolayer thicknesses are obtained due to the quantum size effect of the Ag valence electrons confined between the film surfaces and interfaces. In detailed observations using scanning tunneling microscope (STM), we studied the competition between surface kinetic and quantum-driven processes at the surfaces, and clarified the effects of the deposition temperature and lattice mismatch between Ag and Si on the obtained Ag nanofilm's morphology in the two-step growth.

### **(ii) Control of Ge/Si lattice misfit strain by B dopant atoms**

Strained Ge/Si is one of the promising candidates among post-Si materials for high-speed electron devices. However, due to the misfit strain between Ge and Si, the Ge layer tends to grow via three-dimensional island formation. No atomically flat Ge layers could be obtained for the critical thickness above 3 bilayers (BLs). We tried to cancel the lattice mismatch by introducing B dopant atoms of the atomic radius smaller than Ge and Si in this study. Using an apparatus with STM and molecular beam epitaxy (MBE), we studied the Ge growth processes with B dopant atoms in detail on Si(111) substrates. Counting the number of surface B atoms in the STM images, we elucidated that the surface segregation of B dopant helps to increase the critical thickness.

## **2. Articles**

1. Scattering of the S<sub>1</sub>-surface state electron by an isolated adatom at Si(111) $\sqrt{3} \times \sqrt{3}$ -Ag surface :  
S.Minamoto, Y.Ogawa, Y.Sano & H.Hirayama  
Physica E 40, pp.324-327(2007)
2. Electron Confinement in a STM-lithographed Nanoscale Domain on an Si(111) $\sqrt{3} \times \sqrt{3}$ -Ag Surface at Room Temperature:  
S.Minamoto, T.Ishiduka & H.Hirayama  
Surface Science 602, pp.470-474(2008)
3. Thickness- and Deposition Temperature-dependent Morphological Change in Electric Growth of Ultra-thin Ag Films on Si(111) Substrates:

M.Miyazaki & H.Hirayama  
Surface Science 602,pp.276-282(2008)