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Single Electron Charging and Tunneling Effects in Nanometer sized Ag Quantum Dots Grown on Silicon Surface

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We have investigated the room temperature single electron charging and tunneling effects at the nano-sized Ag droplets grown on Sb-terminated Si(100) surface with scanning tunneling microscopy (STM). A well ordered Sb-terminated Si(100) surface was made by deposition of Sb on a clean Si(100) at 375 °C, and subsequent annealing at 450 °C. On the Sb-terminated Si(100), the dangling bonds of the surface Si atoms were saturated through bonding with the overlayer Sb dimers. The Sb layer eliminated the interaction between Ag and surface Si atoms and caused the significant change of growth behavior of Ag on silicon. In particular, the Ag islands were formed in a manner very close to the atomic defect structure of Si(100). Averge sizes of Ag droplets were controlled from 1 to 10 nm with variation of Ag coverage, and the single electron tunneling effects were studied with the local current-voltage (I-V) measurements on the various sized Ag droplets. The I-V characteristics were very sensitive to the size of Ag islands and the measurement position withinthe same droplet. Those behaviors were analyzed in terms of the metal(tip)-vacuum-metal(Ag)-semiconductor(Si) double junction structure. We have considered the charging and transfer mechanism of tunneling electrons from the tungsten tip in Ag-Si Shottky junction to describe I-V characteristics at room temperature.