Metal Nanostructures Assembled At Semiconductor Surfaces For Anchoring And Communication In Molecular Devices

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Technology of atomic scale conductive interconnects to a single molecule on one side and to nanoscopic atomically oriented metallic pads on the other side, is vital for successful communication between nano- and micro- environment of the electronic circuit. Suitable solutions for such a task might be obtained by thermally-assisted assembling processes occurring at atomically ordered surfaces of AIII-BV semiconductors. Dynamic Force Microscopy (DFM), Kelvin Probe Force Microscopy (KPFM) and Scanning Tunnelling Microscopy/Spectroscopy (STM/STS) have been used to study epitaxial nanostructures formed as a result of sub-monolayer deposition of silver and gold on clean reconstructed InSb, InAs and Ge surfaces. It has been found that both topography and composition of the structures are strongly dependent on the substrate temperature during evaporation. In the particular case of Au deposited on c (8x2) InSb(001) surface at 300 K, the nanostructures have predominantly the form of rectangular islands with edges oriented along <110> and <1-10> directions (see Fig. 1a).

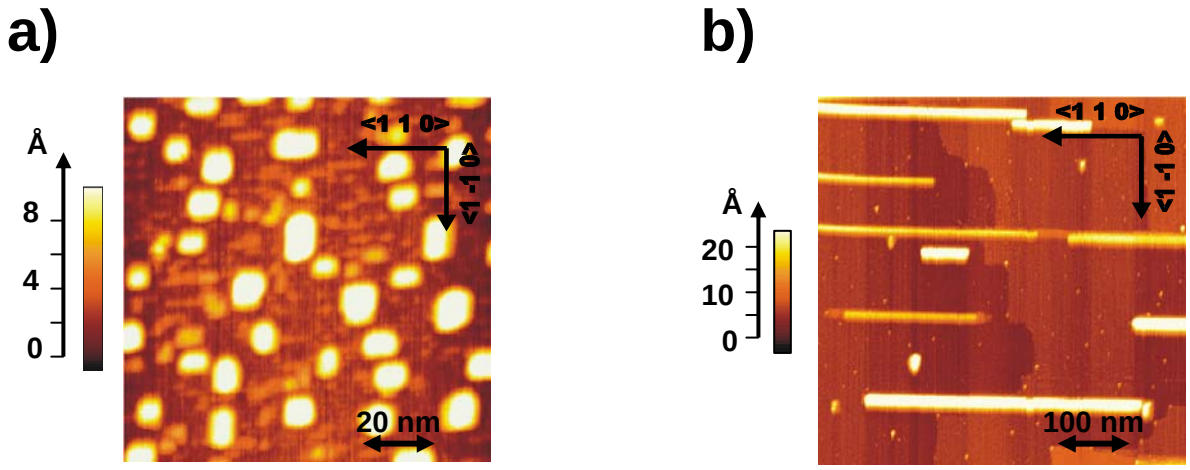

Fig. 1. Nanostructures created by Au evaporation (<1ML) on InSb (001) surface at various temperatures. a) The substrate kept at 300 K. The average island dimensions are: length 50-100 Å, width 50-100 Å, and height 2-8 Å. b) The substrate kept at 600 K. The average wire dimensions are: length 3000-8000 Å, width 100-50 Å, and height 8-12 Å.

Increasing the substrate temperature up to 600 K during deposition results in formation of narrow, long structures (nanowires) with an average length of 800 nm as seen in Fig. 1b. The nanowires are created along troughs of the reconstructed InSb (001) surface.

High resolution KPFM and STS measurements indicated that nanowires of different heights could have different chemical composition and electronic structure. For comparison, the structures assembled by silver deposition on the same substrates have been investigated with various SPM probes. It was found that topographies and composition of Ag-based nanostructures are different from the gold ones.