Low temperature STM/STS study of silicon nanowires grown on the Ag(110) surface

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The production of low-dimensional nanostructures and the study of their peculiar electronic and optical properties is a hot topic attracting growing interest in the scientific community. In particular, monodimensional (1D) nanowires are under investigation for their potential use for the achievement of nanosized electronic devices. One method for realizing such nanostructures is the so-called bottom-up approach. In our case, silicon nanowires are obtained by self assembly of silicon deposited on the Ag(110) surface. The immiscibility of silicon and silver ensures that no silicides are formed at the surface, while the anisotropy of the substrate acts as a template for the formation of such monodimensional nanostructures.

A partially covered surface shows isolated nanowires all oriented in the same [-110] direction with an internal periodicity of about 0.58 nm along the wire (2 times the substrate periodicity in the [-110] direction), and characterized by well defined widths of about 0.8 and 1.6 nm (2 or 4 times the substrate periodicity in the [001] direction). The fully covered surface shows a very highly ordered crystallographic structure in which 1.6 nm wide parallel nanowires are packed in a 5x periodicity in the [001] direction (perpendicular to the wire). [1-3]

Synchrotron radiation Photoemission Spectroscopy results confirm the highly ordered internal structure of the wires with the presence of two very sharp components of the Si-2p core levels, while valence band spectra suggest a highly metallic behavior for the silicon nanowires. [1-2]

Here, we report a Scanning Tunneling Microscopy (STM) and Spectroscopy (STS) study as a function of temperature (ranging from room to liquid helium temperature) of the Si/Ag(110) surface with different silicon coverage, namely a) the bare silver surface, b) the partially covered surface and c) the fully covered one.

The internal wire structure will be discussed by examining high-resolution STM images acquired at low temperature and the electronic properties studied by STS, showing a clear metallic behavior, will be reported as well.

References

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