STM/AFM studies of ultrathin Sb layers growth on SiC(0001)

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Scanning probe microscopies (SPM) are useful tools not only for imaging but also for surface engineering. In this study scanning tunneling microscopy (STM) and atomic force microscopy (AFM) have been used for direct observation of the growth of ultrathin films of Sb on the 6H–SiC(0001) surface and as a tool for topography modification of the Sb films. Complementary X-ray photoelectron spectroscopy (XPS) and low energy electron diffraction (LEED) have been used. The Sb layers were deposited under ultra high vacuum (UHV) from a heated by electron bombardment evaporator. After standard cleaning procedures the substrate was additionally cleaned *in situ* by cycles of annealing. Cleanliness, atomic structure and topography were then checked by XPS, LEED and AFM/STM. Prior to Sb deposition the surface consists of wide and flat terraces and steps of 5-lattice-constant height on average and displays typical hexagonal LEED pattern.

The growth of Sb films follows the Volmer–Weber (VW) growth mode (see Fig. 1 (a) and (b)). The Sb grains are very weakly bound to the substrate and could be easily moved over the surface by the AFM tip working in the contact mode. The grains disintegrate when the STM tip bias voltage exceeds 3 V (see Fig.1 (c)). The effect is very strong for positive and rather week for negative bias. Further growth leads to coalescence of the grains and the formation of Sb crystallites, as it is visible in Fig. 1 (d). The Sb crystallites are epitaxially oriented. The largest of them grow around screw dislocations.

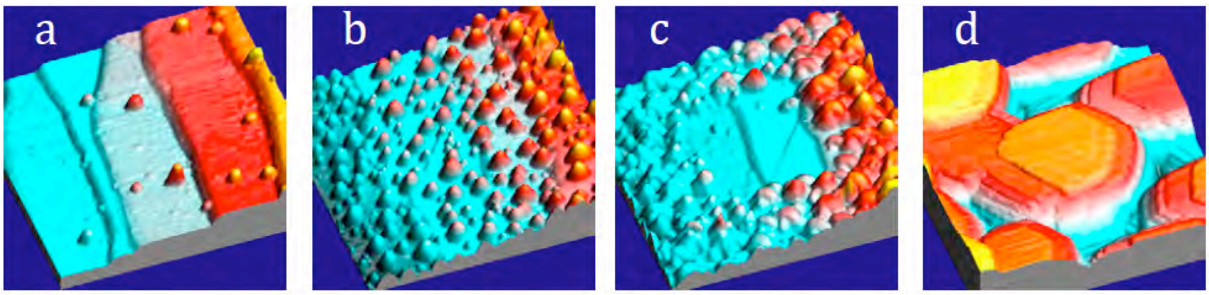

Fig. 1 STM topographies of Sb films grown on the 6H–SiC(0001) surface. (a) The first stage of the growth: typical step-and-terrace topography of the substrate is visible (imaged area: 1000 x 1000 nm^2); deposited Sb forms randomly distributed semispherical grains (of about 80 nm diameter at the base and the height equal to 20 – 30 nm in average). (b) Further growth results mostly in the increase of stacking density of the Sb grains that dimensions remain almost unchanged. (c) The Sb grains decompose during prolonged scanning of the STM tip over the same surface area exposing the topography of clean surface as it visible at the center of the imaged area where Sb has been removed form the square of about 500 x 500 nm^2. (d) STM topography of the beginning of coalescence of the Sb grains (imaged area: about 200 x 200 nm^2).