S2-P012

Temperature-dependent Sb-induced facetting of Si(5 5 12)-2x1 from (225)/(112) to (113)/(335): Role of Sb-inserted 5-7-5 rings of Si surfaces.

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The atomic structure of Sb/Si(5 5 12)-2×1 surface, deposited at room temperature (RT) and post-annealed, has been identified by scanning tunneling microscopy and the corresponding interface has been studied by synchrotron core-level photoemission spectroscopy. With 0.3-nm Sb deposition at RT and postannealing at 600°C, the surface has been facetted to (225)-2x1 and (112)-1x1, and its Si 2p has shown that all the Si 2p surface components have disappeared, while the single Sb-Si interfacial component has appeared. Such results indicate that all of surface Si atoms are replaced by Sb atoms and the charge is transferred from Si to passivating Sb-atoms at the top layer. With subsequent postannealing up to 700°C, the surface has been facetted to (113)-2x2 and (335)-4x2, still having Sb-Si interfacial component and partially re-exposed Si surface components. From the present study, the role of surfactant atom, Sb, as well as the thermal-stabilization of Sb-passivated high-index Si surface will be exposed. Especially, the key role of the Sb/Si(113)-2x2, composed of Rebonded-Dimer-Rebonded atom 1D structures, for stabilization will be discussed.