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Can the S-K growth mode be applied to the flat
high-index Si surfaces? : Ge/Si(5 5 12)

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It has been known that Ge with 4 % lattice-mismatch has a film-like growth mode only at the initial stage on Si(001) as well as Si(111), so called the Stranski-Krastanov growth mode. Then the question of the same S-K growth on the high-index Si surface between Si(001) and Si(111), such as Si(5 5 12) which is located at 30.5 degree from Si(001), has been arisen, since Si(5 5 12)-2x1 has a relatively flat reconstructed surface. Hereby, initial growth-stages of Ge on Si(5 5 12)-2x1 has been studied by STM. Initially Ge dimers of 2x periodicity have been aligned along [1 -1 0] at the dimer/adatom(D/A) adsorption sites of the clean and reconstructed Si(5 5 12)-2x1 held at 500 C. Upon saturating D/A sites, the aligned Ge dimers of 2x periodicity on D/A sites of (225) unit firstly transform to a 1x chain, and another 1x chain between (225) and D(337) units transforms to a tetramer row as in the Si-homoepitaxy case. The stress induced by these transformations caused T(337) to be D(337), which results in transformation of one (5 5 12) periodicity from [D(337), (225), T(337)] to [(225), T(337), D(337)]. When two (225) units are adjoining, they become faceted to (113) and (112) through the same transformations. With additional Ge, the surface becomes covered with sawtooth-like facets composed of (113)-3x2 and (112)-5x2 with the periodicity of 10-20 nm. With increased Ge deposition, the valley is filled with (337) facets until all (112) facet portions are consumed. Finally, the surface becomes rugged and three dimensional huts appear. This growth mode implies that the most stable orientation Ge/Si(5 5 12) is (337), and the Stranski-Krastanov growth mode is not applied to this orientation, (5 5 12), that is, Ge favors a different orientation, (337), even on (5 5 12).