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PII: S0022-0248(14)00433-3
DOI: http://dx.doi.org/10.1016/j.jcrysgro.2014.06.049
Reference: CRYS22320

To appear in: *Journal of Crystal Growth*

Received date: 10 June 2014
Revised date: 26 June 2014
Accepted date: 27 June 2014

Cite this article as: S.A. Teys, K.N. Romanyuk, B.Z. Olshanetsky, Structure of initial Ge nanoclusters at the edges of Si(1 1 1) steps with the front in the $<$-1-12$>$ direction, *Journal of Crystal Growth,* http://dx.doi.org/10.1016/j.jcrysgro.2014.06.049

Structure of initial Ge nanoclusters at the edges of Si(111) steps with the front in the <-1-12> direction.

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Abstract:

Initial stages of the formation of Ge nanoclusters at the edges of steps in the case of the deviation of Si(111) surface in <-1-12> direction were studied with the help of ultrahigh vacuum scanning tunneling microscopy under the quasi-equilibrium growth conditions. On the basis of the analysis of the surface images with atomic resolution, the sequence of structural changes at the edges of steps during the initial formation of Ge nanoclusters was established. The atomic model of the stable initial nanoclusters in the half of unit cell of increased size of the surface structure 9x9 was proposed. Features of the atomic structure affecting the transfer of adsorbed atoms across the step were discussed.

Keywords: Nanoclusters, steps, Si, Ge, STM

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I. Introduction

There are two kinds of steps [1] on real surfaces of Si(111) with the height equal to one interplanar spacing ($1d_{111}$) or 1 bilayer (BL), alternating in the (111) plane every 60^o. Different steps are formed when the surface deviates from the (111) orientation by means of rotation around a <110> type axis in two opposite directions, for example [11-2] and [-1-12], or to the planes {110} and {100}, respectively.

The edges of the steps of the 1^{st} type with the front in <11-2> directions should contain the atoms with one dangling or unsaturated bond. The edges of the steps of the 2^{nd} type, perpendicular to the family of <-1-12> directions, must contain atoms with two dangling bonds. This ideal