DOI 10.1007/s11182-017-1082-y

Russian Physics Journal, Vol. 60, No. 2, June, 2017 (Russian Original No. 2, February, 2017)

PHYSICS OF SEMICONDUCTORS AND DIELECTRICS

GROWTH OF EPITAXIAL SiSn FILMS WITH HIGH Sn CONTENT FOR IR CONVERTERS

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UDC 621.315.592

Growth of SiSn *compounds with a* Sn *content from 10 to 35% is studied. The morphology and surface structure of the* SiSn *layers are examined and the kinetic diagram of the morphological state of* SiSn *films is established in the temperature range of 150–450°C. During the growth of* SiSn *films from 150 to 300°C, oscillations of specular beam were observed. For the first time, periodic multilayer* SiSn/Si *structures with pseudomorphic monocrystalline* SiSn *layers with the* Sn *content from 10 to 25% are grown. The c(8×4) and (5×1) superstructures are identified during the growth of* Si *on the* SiSn *layer and the conditions are determined for the formation of the desired* Si *surface structure by controlling the growth temperature. From the diffraction reflection curves, the lattice parameter, the* SiSn *composition, and the period in the multilayer periodic structure are defined, which with high precision correspond to the specified values.*

Keywords: diffraction, oscillation, heterostructure, a monocrystalline layer, the superstructure, the lattice parameter, rocking curve, direct bandgap material, photonics.

INTRODUCTION

Currently great efforts are concentrated on the GeSiSn compounds. With introduction of Sn, it becomes possible to implement multiple devices based on Si in photonics and optoelectronics in the near and middle infrared ranges [1, 2]. Today, photodetectors [3], LEDs [4], resonators [5], and lasers with optical pumping are created on the basis of the GeSiSn materials. Laser generation in the structure containing a GeSn layer was demonstrated in [6]. The emission wavelength covers the range of 2–2.3 μm and is associated with the direct transitions in GeSn [6, 7]. These values are higher than the wavelengths used in fiber-optic communication lines (FOCL). One of the methods to obtain a direct bandgap material corresponding to the range of FOCL, is the introduction of Sn in Si. Because the direct transition has a negative value for the gray tin (–0.4 eV), the SiSn alloy should become direct bandgap material for the sufficiently large Sn content. Calculations of the electronic structure showed that introduction of Sn into the lattice of Si reduces the value of the direct transition much faster than that of the indirect one [8]. The calculations proposed for the SiSn band structure simulation predict different Sn content, at which the material becomes a direct bandgap one. Calculations within the virtual crystal approximation predicted that the transition occurs at a content of Sn of about 55% [9], while a simple method of approximation using linear interpolation between the values of the forbidden band widths of Si and α-Sn gives the direct transitions at a content of Sn greater than 90% [10]. The authors of [11] report that the

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 1064-8887/17/6002-0354 ©2017 Springer Science+Business Media New York