GROWTH OF TWO-DIMENSIONAL LAYERS ON GRAPHITE SUBSTRATES*

O.I. KUKENOV[1], V.V. DIRKO[1], K.A. LOZOVOY[1], A.P. KOKHANENKO[1]

[1]National Research Tomsk State University, Tomsk, Russia

Two-dimensional silicon (silicene), germanium (germanene) and antimony (antimonene) have attracted special attention from researchers in recent years. The main method for creating graphene-like materials is their epitaxial growth on lattice-matched substrates. At the same time, highly oriented pyrolytic graphite (HOPG) and graphene are some of the promising substrates for growing silicene, germanene, and antimonene [1, 2]. However, to date, the processes occurring during the epitaxial growth of silicon, germanium and antimony on the surface of such substrates have been poorly studied [3, 4].

In this work, the epitaxial growth of silicon, germanium and antimony is studied directly during the deposition of material onto the surface of highly oriented pyrolytic graphite using high-energy electron diffraction. In addition, the obtained samples were studied by Raman spectroscopy and scanning electron microscopy. A wide range of deposition temperatures from 100 to 800 °C is considered and temperature ranges are determined for various growth modes of silicon, germanium and antimony on highly oriented pyrolytic graphite.

It has been shown that at temperatures close to room temperature, materials grow amorphously, and at high temperatures polycrystalline growth is observed. It has been established that in the temperature range of 250–400 °C the crystal structure of silicon and germanium during 1 monolayer repeats the structure of graphite, and then reflections of the $1/N$ type appear in the diffraction pattern (N(Si) = 1.56 and N(Ge) = 1.62), which correspond to the lattice constants of silicene and germanene and may indicate the presence of areas of graphene-like 2D phases during epitaxial deposition of silicon and germanium onto the surface of highly oriented pyrolytic graphite.

The results obtained can be used to develop technology for growing silicene, germanene and antimonene. In addition, the presented results will also be valid for the epitaxial growth of silicon and germanium layers on graphene.

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