A new method for the synthesis of epitaxial layers of SiC on Si. *Thermodynamics and kinetics of materials synthesis by new method of atoms substitution. Nano-SiC on Si – a new material for micro- and optoelectronics*

S.A. Kukushkin

Institute of Problems of Mechanical Engineering RAS,

V.O., Bolshoj pr. 61, St. Petersburg, 199178 Russia

e-mail: sergey.a.kukushkin@gmail.com

A modern state of the growth of epitaxial SiC films on Si is presented by a new method of atoms substitution. An ideology of the new method of SiC synthesis on Si is stated and a comparison of the theoretical statements with the experimental results is provided [1-4]. The method consists in replacing a fraction of atoms of the silicon matrix by the carbon atoms to form molecules of silicon carbide. It was experimentally discovered that the process of substitution of Si matrix occurs gradually without destroying its crystal structure. The film orientation is set therewith not only by the surface of the silicon substrate but by the crystal structure of the original silicon matrix. A comparison of the new method of growth with the classical methods of thin film growth is presented. The properties of the realized SiC layers are specified in detail. It is described a new type of phase transformation in a solid phase with a chemical reaction conducted through an intermediate state. By the example of chemical interaction of CO gas with monocrystalline Si matrix, the mechanism of behavior of a broad class of heterogeneous chemical reactions between the gas phase and solid has been revealed [1-4]. Using this mechanism, it has been possible to obtain a new kind of templates, i.e. the substrates with buffer transitional layers aimed for growing wide bandgap semiconductors on silicon. On the SiC/Si substrate grown by the solid-phase epitaxy on silicon, it has been managed to grow a number of heteroepitaxial films of wide bandgap semiconductors, such as SiC, AlN, GaN, AlGaN, CdS, ZnO. The synthesis of low-defect SiC layers on Si with a diameter of 150 mm is described.

The grown films contain no cracks and have quality sufficient for the manufacture of a wide range of micro- and optoelectronics devices [5].

References

[1] Kukushkin S A, Osipov A V, 2008 *Physics of the Solid State* **50** 1238

[2] Kukushkin S A, Osipov A V, 2012 *Doklady Physics* **57**, 217

[3] Kukushkin S A, Osipov A V, 2013 J*. Appl. Phys.* **113**, 4909

[4] S.A. Kukushkin and A.V. Osipov. Topical Review. Theory and practice of SiC growth on Si and its applications to wide-gap semiconductor films. J. of Phys. D: Appl. Phys. 2014. 47. 313001-313041.

[5] Kukushkin S A, Lukyanov A V, Osipov A V, and Feoktistov N A, 2014 *Tech. Phys. Lett.* **40**, 36