

Some design and applying aspects of Molecular Beam Epitaxy (MBE) machine Main Units in Ultra-Vacuum of Space

D.N. Pridachin (1), O.P. Pchelyakov (1,2), A.I. Nikiforov (1,2), L.V. Sokolov (1), V.V. Preobrazhenskii (1), V.V. Blinov(1)
(1) Rzhanov Institute of Semiconductor Physics, Siberian Branch of the Russian Academy of Science, Novosibirsk, Russia
(dnp@isp.nsc.ru), (2) National Research Tomsk State University, Tomsk, Russia.

Abstract

Solar cell-assisted energy generation is believed to be the most attractive now. The technology does not require any regenerative energy sources (oil, coal, uranium, etc.). It is of low environmental pollution. MBE - the method of obtaining semiconductor films on single-crystal substrates - is, probably, the basic technological way to get the structures for solar cells [1].

More than twenty years Rzhanov Institute of Semiconductor Physics, Siberian Branch of the Russian Academy of Sciences (ISP SB RAS), in co-operation with colleagues from Moscow and Krasnoyarsk, has been developing devices for MBE semiconductor film growth in Space. The device is to be mounted in the Russian segment of the International Space Station and, on Earth; operations are being carried out on the simulator-stand to work out the modes and testing [2].

The MBE machine scheme with a description of the main units and the principles of their operation are presented in the report. The growth chamber design, substrates heater, a cassette with the samples and a drive movement, also a unique design of molecular sources for elements III and V groups are specially focused on. The design of molecular sources has its peculiarities determined by using them under weightlessness [3]. Testing the source was realized using the "Katun-B" MBE machine. High-quality GaAs epitaxial films were grown.

Creation of hi-tech equipment, including the one that provides carrying out experiments in epitaxial semiconductor film growth in orbital flight conditions, requires a solution of non-standard tasks which are impossible to come across on Earth. The source of molecular flux that can be used in orbital

flight conditions was developed, fabricated and successfully tested on ISP SB RAS.

References

- [1] Ignatiev, A., Freundlich, A., Pchelyakov, O.P., Nikiforov, A.I., Sokolov, L.V. and Pridachin, D.N.: Molecular - Beam Epitaxy in the Ultra - Vacuum of Space: Present and Near Future. In: Molecular Beam Epitaxy: From Quantum Wells to Quantum Dots; From Research to Mass Production (Chapter II), Editor: M. Henini, Elsevier, 2013;
- [2] Blinov, V.V., Zvorykin, L.L., Ivanov, A.I., et al.: The System for Molecular - Beam Epitaxy in Space and its Terrestrial Stand – simulator, 2nd International Symposium on Nanotechnology, Energy and Space, 3 – 5 August, 2011, Chernogolovka, Russia.
- [3] Feklin, D., Semyagin, B.R., Putyato, M., et al.: Unique Effusion Cell for Molecular-Beam Epitaxy (MBE) in Orbital Flight Conditions, 3rd International Symposium on Nanotechnology, Energy and Space, 6 – 8 August 2013, Almaty, Kazakhstan.