Control of Wide Band Gap Semiconductor properties By Radical Beam Quasiepitaxy Method

Description

Security The Radical Beam Quasiepitaxy Method

The RBQE enables us to grow quasi-epitaxial layers of ZnO on the surface of binary compound such as ZnO, ZnS, ZnSe ZnTe. During the formation of new layers under RBQE the non-metal component comes from the gaseous phase and the metal-component from the basic crystal. Also, basic crystal is placed in the area of maximal temperature of the reactor. With regulation of temperature (300 to 1500 K) we can control of diffusion speed of A component. In role of non-metal component we use singlet radicals of oxygen with concentration N=1014-1015cm-3. This causes controlling the relationship of A and B components and consequently, of electro-optical properties of obtained layers.

Thus, the RBQE method enables to control the electrical and optical properties of basic crystal as well as the grown layers.

Innovative Aspect and Main Advantages

The RBQE method was specifically designed for resolving of electro-optical properties regulation problems in wide gap semiconductors. The RBQE method doesn't substitute other epitaxial methods the MBE or MOVPE. The substrate used under RBQE is the very semiconductor crystal optoelectronic properties of which will be regulated. Therefore, first the semiconductor sample will be obtained by an established method and the RBQE will be used for effectively control of their optoelectronic properties. Application of the materials and structures obtained by the RBQE technology will increase their resistance to degradation of structures, resistance to temperature, radiation and other outer impacts. Obtaining of optoelectronic application and devices for information communication will increase speed and quality of communication system.

Under RBQE Size of substrate varies 1-4cm2. The speed of growth is ~ 10µm/hours. The thickness of obtained layers varies from few atomic layers to 50µm.

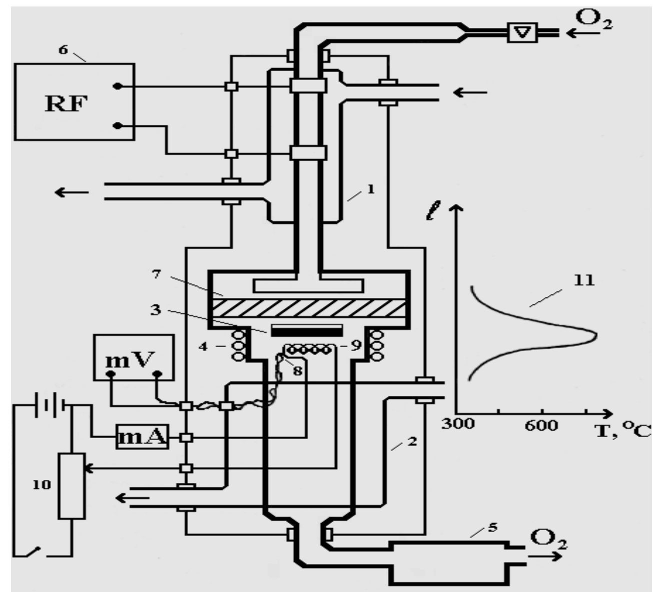
Areas of Application

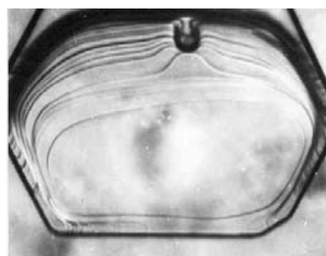
By means of the RBQE technological method it is possible to obtain semiconductor materials working in extreme conditions. By RBQE it is possible to obtain the unique applications: ZnMnTeO highest (57%) efficiency solar bataries; p-n junction ZnO/ZnO structures for computer chips, UV diodes, UV lasers and other optoelectronic devices and controling system of communication. The concept implemented in RBQE method exceeds the boundaries of one semiconductor, the range of its future application will cover all compounds with two components like: ZnS, ZnO, ZnSe, GaN, Al_2O_3 etc. (one metal, another non-metal).

Stage of Development

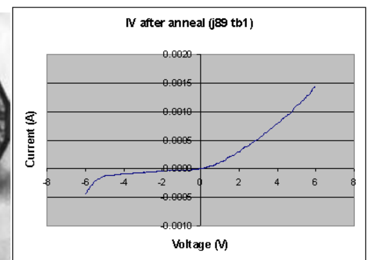
By RBQE method were obtained p-type layers of ZnO on the basic of ZnO samples. Hall effect measurements results showed following characteristics carrier mobility, carrier concentration and resistivity **230 ÷250 cm2/Vs, 7 ÷ 8 × 1018cm-3 and 3.9 ÷ 3.1 × 10-3Ωcm** respectively.

We intend to get an international patent for this technological method.





The photo of ZnO layers growing



I –V characteristic of p-type ZnO structures obtained by RBQE method.

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