POSSIBILITIES OF LOW-ENERGY ION IMPLANTATION IN OBTAINING NANOMATERIALS

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ABSTRACT

The implantation of medium and high energy beams is used for the formation of p- or n-type compounds in semiconductors. In recent years, they have also been used to obtain nanodots in deep layers. Low-energy ion implantation is mainly used to modify the surface layers of solids, and to obtain nanophases, nanoclusters, nanocrystals, and nanofilms.

***Key words**: Low energy ion implantation, modification process, diffusion arrangement, ion-doped layer, ion-deformed layer, single crystal nanomaterials, nanopleons, laser technologies, emission properties.*

INTRODUCTION

Possibilities of low-energy ion implantation in obtaining nanomaterials. Depending on the energy, the ion implantation method can be conditionally divided into 3 types:

1 - low energy Ei≈0.2-10keV
2 - medium energy Ei≈10-50keV
3 - high energy Ei>50keV

MATERIALS AND METHODS

The implantation of medium and high energy beams is used for the formation of p- or n-type compounds in semiconductors. In recent years, they have also been used to obtain nanodots in deep layers. Implantation of low-energy ions is mainly used to modify the surface layers of a solid body, and to obtain nanophases, nanoclusters, nanocrystals, and nanofilms. The modification process can be carried out without a reaction on the surface, as a result of which the physical properties of the surface change and the secondary emission property increases. Ion bombardment - the ions hitting the target may or may not remain in the sample. In ion implantation, the ions remain inside the target. In low-energy ion implantation, the ions are mainly deposited in the surface and subsurface layers of the solid. When ions hit the surface of a single crystal, some of them can continue their movement through the channels, and this can continue for long distances.

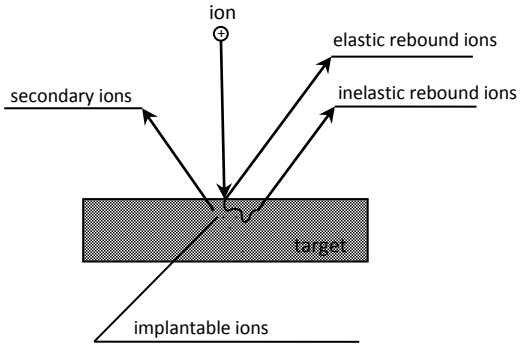


Figure 1. Phenomena occurring at the surface during ion implantation

There are two types of channeling: axial and horizontal. The main part of the ions starts to disperse randomly and settle in the subsurface layers, such a settlement is called diffusion settlement. They are located at a certain depth depending on the energy. Layers containing ions are called ion-doped layers. The ion doped layer and the layers below this layer, which are 2-3 times larger than the doped layer, break the crystal lattice and start to become amorphous.

After ion implantation, heat or laser treatment is used to crystallize the amorphous layers to form the desired briquette.

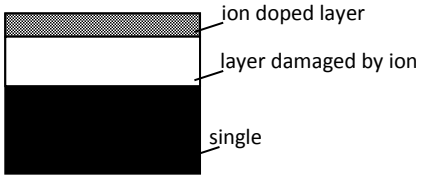
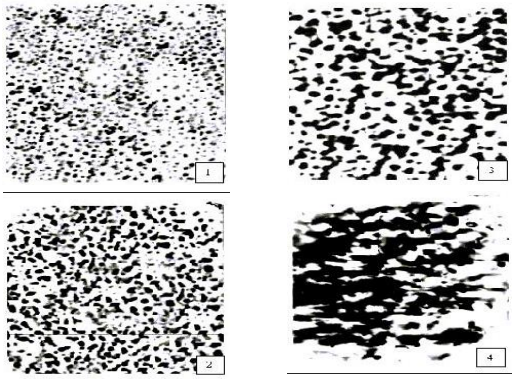


Figure 2. Appearance of ion-doped layer

RESULT AND DISCUSSION

Experiments show that in small doses D < 1015 cm-2 ions fall on separate areas of the surface, these areas can be called nanoclusters in a conventional way, and islands in larger ones. These samples can be heated to form single crystals. By this method, BaSi2, CoSi2¬ on Si surface; Nanoclusters of GaxBa1-xAs and GaxNa1-xAs were obtained on the surface of GaAs.



3 – picture. Appearance of Si(111) surface doped with Ba+ ions, Ei=1keV

When the dose of ions increases, the clusters expand and islands are formed, at large doses D>10^{16} cm^{-2} a single alloyed layer is formed, and a new type of nanomaterial can be obtained by heating this layer. It is possible to obtain nanomaterials or nanofilms on the surface and subsurface layers of this material by using the ion implantation method to obtain films with the same atoms, mainly by introducing other atoms of a certain dose to the surface and subsurface parts.

CONCLUSION

Materials of this type are widely used in various amplifiers and transistors in laser technologies. If the concentration of ions falling on a unit surface is 10^{14}-10^{15} cm^{-2}, then nanomaterials are formed at different points of the surface, and with increasing dose, nanofilms are formed on the surface.

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