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PENETRATION OF IMPURITIES INTO THE CRYSTAL LATTICE OF SOLID BODIES WITH THE HELP OF ION IMPLANTATION AND BOMBARDMENT.

Elmuradov Rustam Ummatkulovich, Samatov Gulom Bazarbayevich, Abdullayev Abduraxmon, Maripov Ilhom Isakovich, Chuliyev Tohirjon Abdulloyevich, Savronov Doston Rustam ugli

Associate professor ,Gulistan state university,Uzbekistan
Associate professor ,Gulistan state university,Uzbekistan
Associate professor ,Gulistan state university,Uzbekistan
teacher ,Gulistan state university,Uzbekistan
teacher,Gulistan state university ,Uzbekistan
teacher,Gulistan state university,Uzbekistan

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ABSTRACT
This study describes the formation of solid alloys from solid bodies, in particular from metal materials, on the surface of the base, under vacuum conditions, bombardment with gas ions simultaneously by thermal evaporation, in the process of films or coatings of other metal material, as a result of successive swellings of gas ions, radiation-stimulating diffusion occurs and interstellar mixing of atoms of metal materials occurs.

Key words: Diffusion, mixture, ions, implantation, ion bombardment, thermal evaporation, cathode absorption, vacuum, film or coating, crystal lattice, node, defect, cascade, radiation-stimulated diffusion, vacancy, migration, dislocation, microcaticity, adhesion, electrical conductivity, corrosion, thermal conductivity, relaxation, recombination, annihilation, thrombolysis, clustering.

1. INTRODUCTION

Under normal conditions, the amount of atoms and molecules of the surrounding medium, that is, gas molecules or other substances that diffuse into the crystal lattice of solid bodies, in particular metals, becomes much less. In addition, the diffusion rate of foreign atoms or molecules will also be very small. Therefore, the physical-chemical effects of foreign atoms, which penetrate into the crystal lattice of solid bodies or metals, also occur slowly.In the artificial case of the crystal lattice of solid bodies or metals, it is possible, in different ways, to accelerate the diffusion of foreign gas molecules or atoms of substances in large quantities and at a sufficiently large speed, that is, to penetrate foreign admixtures into the crystal lattice.

2. METHODS

So far, several methods of introducing foreign impurities into them have been created, without violating the crystal structure of solid bodies or metals. To such methods: 1. Implantation of gas molecules or atoms of substances into diapers (niches) made of different metals, accelerating them in the electric field, giving a large amount of energy; 2. To ionize and bombard gas molecules on bottoms made of solid bodies or metals; 3. In the process of thermal evaporation or cathode absorption of other substances to the surface of solid bodies or metals, in the process of growing planks and coatings, it is possible to bring such methods as ionizing and bombarding gas molecules. The introduction of such artificially foreign impurities into the crystal lattice is carried out in devices with high vacuum dressing. In the first case, the bottoms (targets) can be made of holistic pure metals or solid bodies, or these holistic targets can be made on the surface, in a vacuum, by pre-steaming, on other metal materials, made of plasterboard or coatings (film-bottom system). Here, the system of the film-bottom is obtained by preliminary preparation. The purpose of applying such a film-bottom system is that when the ions are implanted into this system, as a result of collisions, along with the ions, the atoms of the film material also penetrate into the target (bottom) material, that is, from the shock of large-energy ions, the atoms of the film materials move and penetrate, depending on the target material. This leads to the mixing of atoms of two different impurities in the crystal lattice of the target materials. In the second case, too, the ion bombardment is carried out in the film-bottom system, which is grown by steaming into holistic targets or on the surface of the targets. However, since the energy of ions is small, the amount of impurities is small, that is, it is impossible to carry out the introduction of mixtures in sufficiently large quantities. Therefore, a third method was invented. This method is an expression from the cultivation of films and coatings from other substances to the surface of the targets by steaming, at one time, along with ion bombardment of targets made of solid materials.

In all three cases, it is observed that one substance enters the crystal lattice of the material, atoms or molecules of the ionized state of another substance, and in the solid state there is interference, that is, dressing solid alloys. In these cases, the main structural defects do not occur on the crystal surfaces of the bottom material.

When implantation or bombardment of ions into areas close to the surface and the surface of solid bodies is carried out, ions are subjected to non-stop collisions with atoms in the crystal lattice of solid bodies. As a result, the energy of these ions, in collisions, is transferred to the atoms in the crystal lattice, the energy of the ions decreases, stops moving, and the ions settle in the vacancy (empty) places in the nodes of the crystal lattice or in the spaces between the lattices (defectors), that is, form the impurities. The number of these compounds in a unit of volume, that is, their concentration and distribution in the crystal lattice, will depend on the energy of ions, the dose of ions, the type of ions, the density of ions in the bond, as well as the physical-chemical properties of areas close to the surface and surface of solid bodies.

3. RESULTS AND DISCUSSION

As a result of the interference of atoms or molecules of other substances, a large number of, various types of defects, radiation-stimulated diffusion, vacancies, migrations (motion), dislocations occur in the crystal lattice of the target (bottom) material. It turns out that there occur many changes in the material of bottom. This leads to changes in the mechanical properties of the bottom material, changes in microcirculation, toughness, resistance to damage, adhesion (stickness), electrical conductivity, chemical properties, corrosion resistance, thermal conductivity, heat resistance and other properties. From this it follows that as a result of implantation of ions or ion bombardment, it is possible to obtain new materials, the properties of which are improved, by changing the physical-chemical, mechanical, electrical properties of the bottom material. When ions are implanted into solid bodies or when an ion bombardment occurs, these ions are in areas close to the surface and surface of the solid bodies, where the crystal is exposed to collisions many times in a row (cascade). The development of the cascade collision process is qualitatively divided into three stages. The first stage begins with the penetration of ionized atoms or molecules into the base by going to the surface of the base made of solid bodies and continues for $t \sim 10^{-13}$ seconds in the phase of their penetration into the bottom. At this stage, the kinetic energy of the particles involved in the cascade collisions is lower than the boundary energy of the beginning of the movement. This stage is referred to as the stage of collisions. After the collision phase is completed, the cascade is in a strong unregulated state, the mechanical tension (strain) in the crystal lattice (bottom) is very short, approximately $\tau \sim 10^{-12}$ seconds, spontaneously re-combines (covers, finishes) the previously occurring defects, that is, the compound particles are distributed and settled on the crystal lattice. Such a development of the cascade region is called the phase of relaxation. The next stage takes place at approximately $\tau \sim 10^{-11}$ seconds. The cascade (collisions) region will have a higher temperature than the other regions of the crystal lattice, which, in turn, will lead to the movement and partial addition, mating (annihilation) of the point defects in the cascade region. This stage is referred to as the stage of thermolysis (temperature equalization). The phase of thermolysis ends with the equalization of the temperature in the cascade region and other crystal lattice that surrounds this region. The scheme of cascade collisions, which occurs as a result of ion implantation or ion bombardment, on the base materials, is presented in figure 1.

This is indicated by the area of cascade collisions (Figure 1, a) that occur separately, one particle (ionized atom or molecule) and the area of cascade collisions (Figure 1, b) that occur during the flow of particles. When the density of the ion current is j=$1 \frac{mkA}{sm^2}$, the surface of the base occurs between 1-second intervals, a cascade with R=20 $\dot{A}$. Even in the incredibly large values of the peak density, the time of a separate cascade is higher in several embodiments than in the time of deceleration (compensation). Therefore, at the moment of occurrence of the cascade, the density of energy accumulated in a small volume of the base is shaved to a volume that is sufficiently large than the size of the cascade. Thermal (temperature) equilibrium in the cascade area begins to occur. By this time, the concentration of point defects in the Cascade region can be significantly greater than their values in the thermal (temperature) balance. For this reason, conditions arise that cause displacement in new directions on the crystal lattice, the property of radiation defects, which occurs as a result of cascade collisions. Various defects occurring in the crystal lattice have a significant effect on the size of the active energy of the particles. This energy plays a key role in the migration of particles in crystal lattice.

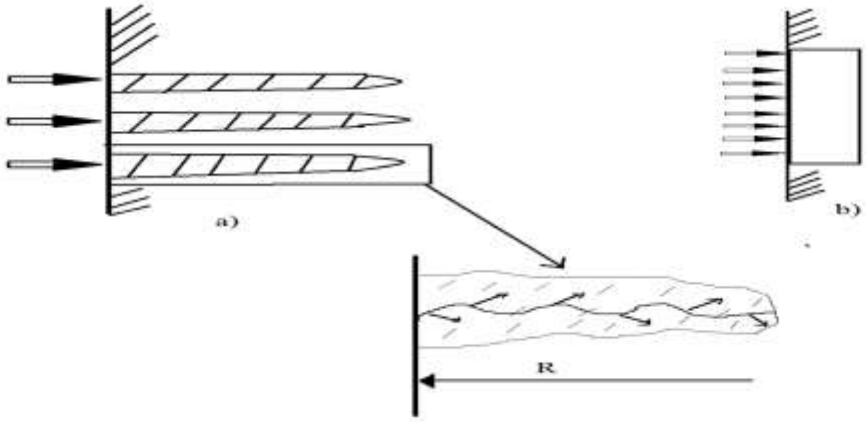

Figure 1. Schematic view of the occurrence of cascade collision. a) separate cascades mode dose of ions, $< 10^{13}\ sm^{-2}$, R=20 A , $t_q = 10^{-12}$ sec; b) cover cascades mode ions dose, $< 10^{13} sm^{-2}$, $t_q = 5 * 10^{-14}$ sec;

For this reason, the radiation deficient coefficients will be large enough from the thermal (temperature) diffusion coefficients in the crystal lattice. Theoretical calculations show that in cascade processes, the diffusion process is more effective than the process of collisions of particles, that is, the mixing process that occurs on the account of diffusion, is greater than the interference that occurs due to collisions of particles. This happens mainly in the process of Ionic bombardments. This is due to the fact that in an ionic bombardment, the energy of ions is low, they lose their energy very quickly in collisions, and the base penetrates into the inner part of the crystal lattice at the expense of diffusion. In the process, it is determined that the silencing of the particles reaches several hundred angstroms. Ionized bombardment, in those areas that are close to the surface of the base, the process of diffusion of particles, in the case of films and coatings that are grown or being grown on the surface of solid bodies are strengthened. As a result of ionic bombardment, defecations that occur in solid bodies (bottoms), increase the chances of the particle's diffusion activity into the crystal lattice. The defects in the crystal lattice can be combined in the form of complex (cluster), this combination is in the form of a compound-defect-cluster, being very active, and with the presence of a gradient of the concentration of defects or a gradient of compound particles, leads to radiation-activated diffusion. The length of this diffusion, that is, the length of the penetration of particles into the base without collisions, can be longer than the depth at which the ions entering through the collisions are bombarded. Radiation-is determined by the length of the activated diffusion, the density of the defects and the free space (vacancies).

4. CONCLUSIONS

When performing ion implantation or ion bombardment, the kinetics energy of particles falling or flying on the surface of solid bodies can be spent in two ways: the first is the energy spent on the atomic nucleus of the bottom material (energy spent on nuclear braking), the second is the energy spent on the atomization of the bottom material. Taking into account this expendable energy, it is possible to approximately determine the basic size of cascade collisions, the distribution of particles in cascade, and the number of silences of atoms in the crystal lattice, inside the cascade, as a result of cascade collisions. As a result of the silencing of the atoms in the crystal lattice of solid bodies from the places they occupy, they come up with a large number of defects. One of these defects is that the gaps are the vacancies, which penetrate into the vacancies, the ions that are implanted or bombarded, or the atoms of the film and coating material, as a result of successive collisions, or as a result of diffusion. This results in the mixing of foreign atoms or molecules into the crystal lattice. This changes the physical, chemical and other properties of solid bodies.

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