INTRODUCTION OF IMPURITIES IN THE CLOSE SPHERES TO THE SURFACE OF METALL FILMS AND COATINGS UNDER THE INFLUENCE OF ION BOMBARDMENT.

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Abstract

With different methods, atoms and molecules of gas molecules or other substances can be introduced into the crystal lattice of solid bodies, in particular metals, as a mixture. This process can be carried out, under vacuum conditions, by the method of bombarding gas ions with ions. In such cases, the amount (dose) of impurities entering the surface and near-surface area of solid bodies or metals into the deposits is much greater than the amount of molecules entering the mixture as a result of the diffusion phenomenon.

On bases made of metal materials, it is possible to simultaneously bombard each other with gas ions, thermally vaporizing different metal material, forming a mixture of plasterboard or cladding, dressing in the kiln-dipping system. This leads to a change in the properties of the metal plate and base. Thus, to explain the changed properties of metals, the penetration of gas ions and other impurities introduced as ion bombardment, the distribution of metals in crystal lattice, their interception in metals, and the very cup changes in the other.

Key words: Materials, atoms, molecules, ions, vacuum, ion bombardment, penetration, close spheres to the surface, crystal lattice, continuous, non-breaking, physical, chemical, mechanical, sequential (cascade) collisions, cathode absorption, base, film formation, film-base system, multi-component, energy, current, ions current density, type of ions, dose of ions, interference, energy exchange, cathode folds, structure, concentration, distribution, structural disorders, defect, vacancy, migration, dislocation, temperature, cascade time, radiasion defects, microclimate, adgesia, electrical conductivity, corrosion, thermal conductivity.

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Obtained results and their analysis

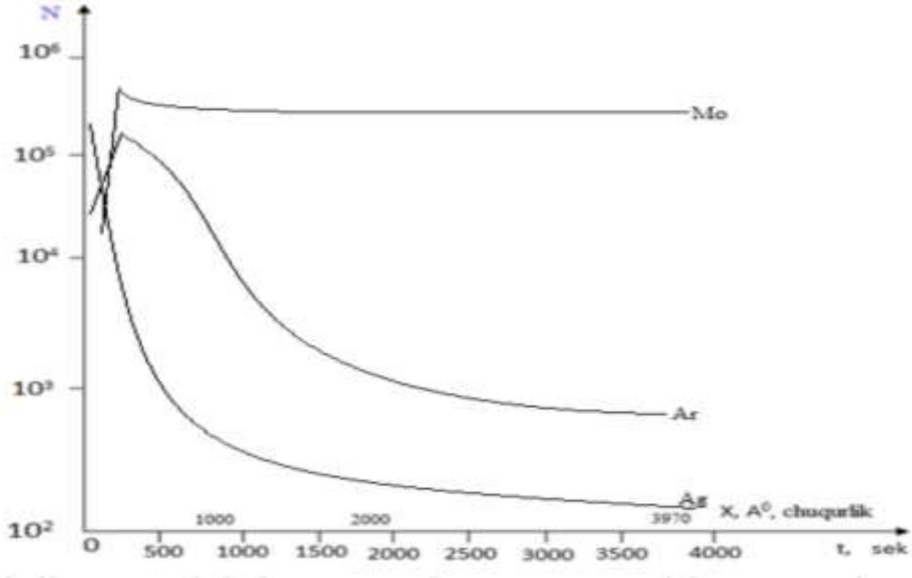
Studying the properties of solid bodies or solid alloys and applying them in practical terms is a very important issue. Because, development and progress in all areas are leading to the creation of new technologies. This, in turn, requires the creation of quality, inexpensive, light, resistant, materials that withstand external influences (corrosion and friction). To do this, it is necessary to study the physical, chemical, mechanical and other properties of solid bodies and mixtures of alloys formed from them in different ways, as well as to obtain results,apply them to production and carry out researches [1].

Such study was carried out in the method of secondary ions mass-spectrometer, on a rare metal-silver plate, which was bombarded with inert gas-argon ions, at one time, in vacuum conditions, on diapers made of molybdenum material.

The finished silver-argon-molybdenum sample (system) is installed on the device of secondary ions mass-spectrometry (SIMS). In this device, a high vacuum is generated. Then this system (sample) is bombarded at a certain angle, with primary-oxygen ions O_2^+ of high energy (E=5-6keV), resulting in cathode absorption. In the cathode absorption, primary ions strike out ionized atoms-secondary ions in the film-base system. These secondary ions fly at an exact angle and are charged with the help of a magnetic field, that is, these ions move in the form of a thin-diameter current, depending on the recording device of the mass spectrometer. During the movement, the electric and magnetic fields, which are mutually perpendicular, are serparated in terms of the ratio of ions-charge to the masses, that is, they separate. Serparated ions come to the recording detector. The detector converts these ions into electrical signalsand transmits itself to the recorder potentiometer. The potentiometer draws spectral graphs corresponding to the changes in electrical signals.

Cathode absorption begins with the film-base system, the film material, and continues until a certain thickness of the base material. This makes it possible to determine the distribution of particles mixed by depth in the system of the film-base, from the surface of the system by a certain thickness [2].

The result obtained is described in Picture 1. This picture shows a graph of the intensity of secondary ions in cathode absorption with oxygen ions, striking from the film-base system, the dependence on the time of cathode absorption and the depth of absorption. As can be seen from the graph, the distribution of argon gas in the silver plate by thickness is observed in the curve, with a slight increase in the border of the film-base, and with the passage of the remaining thicknesses to the base, with a rapid decrease in volume. Similarly, the intensity of silver atoms also decreases with respect to the thickness of the molybdenum base.



Picture 1. Silver, molybdenum and argon
secondary ionization of gas
film-base system with oxygen ions
graph of dependence on the time of absorption. N-secondary
ion intensity; t-absorption time; x-absorption
depth, $\overset{o}{A}$.

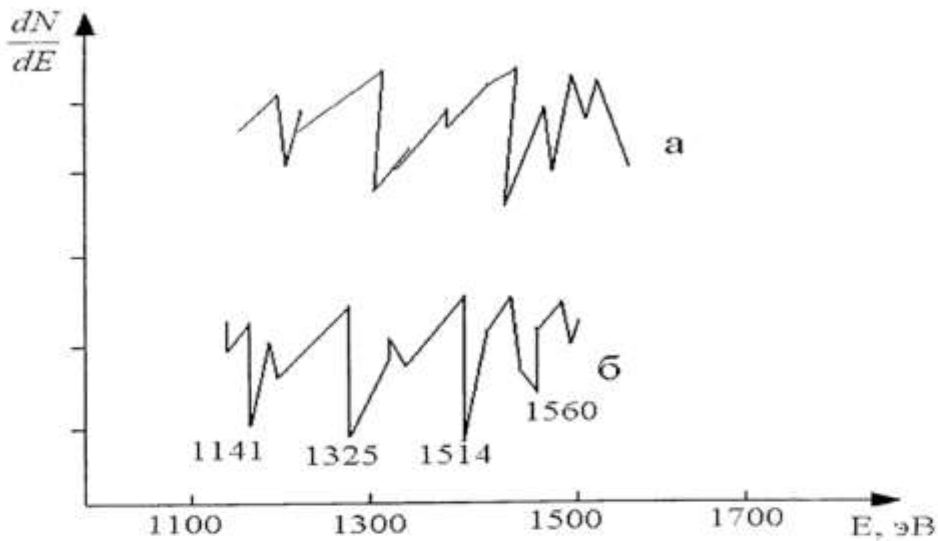
At the boundary of the passage of the film-base system, on both sides, there is a transition of impurities to each other. Such a form of distribution of mixtures, penetrated into the film-base system, corresponds to the results obtained by calculation [3]. These results indicate that, at one time, by bombarding with argon gas ions, silver films grown on molybdenum bases, as a result of cathode absorption, the transition of molybdenum base atoms to the film material, as well as their distribution by settling on the film material. At the same time, under the influence of ion bombardment, molybdenum indicates the penetration, location, distribution of atoms of the film material, as a result of diffusion, into the defects and voids that occur on the crystal lattice of the base. This means that under the influence of ion bombardment, solid alloys are formed as a result of the interference that occurs in the crystal lattice of the film and base materials [4].

One of the techniques that analyzes the surface of solid bodies and areas that are close to their surface is Oje-electronic spectroscopy. With the help of this method, it is possible to obtain information about the content, chemical state of elements in areas close to the surface and surface of solid bodies, the structure of electrons in the crystal lattice [5].

In the Oje-spectrometer, electrons or ions are used as a bombarding particle. Secondary electrons from solid bodies (metals) or metal films and coatings, bombarded with primary electrons or ions, are knocked out. The hit (flown out) electrons are recorded in an Oje-spectrometer and a spectrum is obtained that allows to determine the energy levels of these electrons and what substance they belong to [5]. In this study, the interference process occurring in the copper base as well as in the plates and coatings of the earth metal itterbiy (Yb) material, which is less common, was studied using the Oje-electronic spectroscopy method by simultaneously bombarding with argon gas ions whose energy is E=600 eV and which are grown on bases made of copper material.

The Oje-spectrum, obtained from a plate of itterbiy material and a copper base, which was simultaneously bombarded with argon gas on a copper base, is presented in Picture 2.

The Oje-spectrum is obtained from the bombarded and bombarded parts of the film-basesystem with argon ions. On the low-energy side of the spectrum, there is a peak in itterby with E_2=142 eV intensity in the bombarded part of the film-basesystem with argon ions. In the non-bombarded part, the peak at E_2=147 eV intensity is observed. This indicates that in the bombarded part of the film-base system there is a large chemical shift d=25 eV in the itterby spectrum, in the bombarded part of the film-base system there is a D=20 eV shift. A simultaneous bombardment with argon gas ions was observed, such shifts were also observed in the high-energy parts of the film and coatings grown on copper base materials.

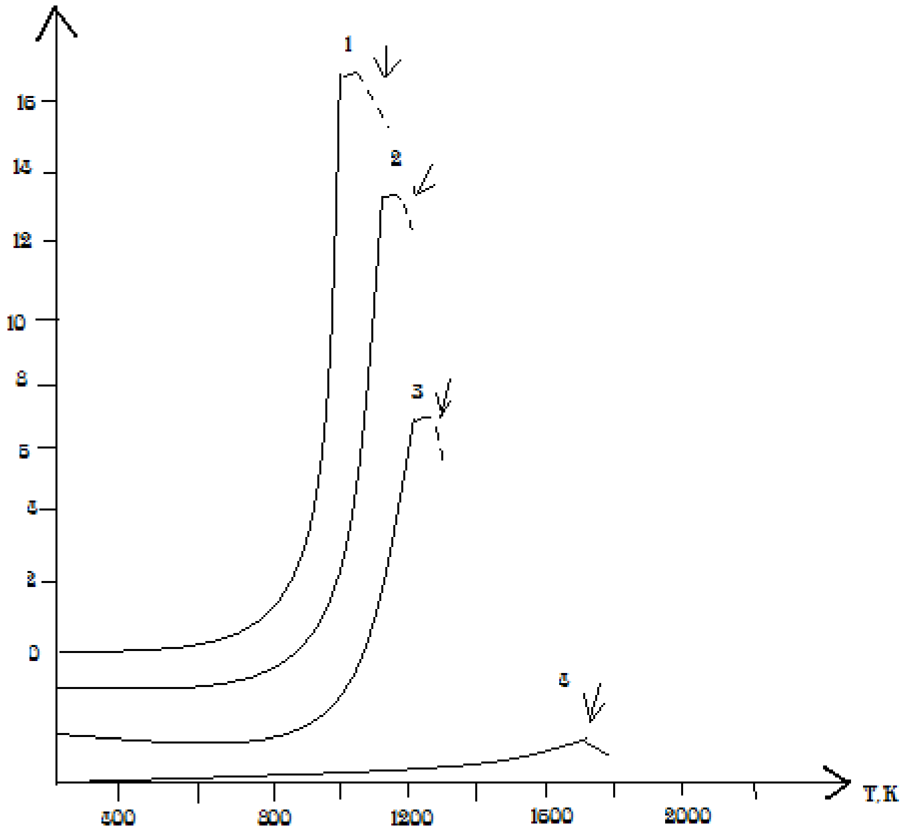


Picture 2. Oje-spectrum graph taken from the base of bombardment with argon gas on a copper basemade of itterium film and copper. a-ionic non-bombarded film and base; b-ion-bombed film and base.

The intensity of the spectrum in the part of the film-base system obtained by bombarding with argon gas ions indicates that the intensity of the spectrum obtained from the non-bombarded part is 1,5 times greater than the intensity obtained from the non-bombarded part. This indicates the interaction of their atoms in the itterby film and coatings, which at one time were bombarded with argon gas ions on copper bases, and in the material of copper bases. When the Oje-electronic spectrum of the copper base was analyzed, it was shown that the atomic concentration of the itterbi material was 2,5 times higher than when the copper base was not bombarded.

As a result of cathodic corrosion of the film-base system, the Oje-electrons of the atoms of copper material were observed in the itterby film, that is, when copper base atoms to the itterby film occurred to pass through the cathodic corrosion. This means that the secondary ion-mass spectrometry and the Oje-electronic spectrometry techniques show that the atoms of metal film and coatings grown on metal bases simultaneously bombard with gas ions as they interact. It should be noted that with no other methods, atoms of metal material can not be confused with each other.

In the method of thermodesorption spectrometry, the spectral graph of the temperature dependence of the separation of argon gas from the film-base systems, as a result of thermal heating, together with tantalum (Ta), molybdenum (Mo) and tungsten (W) materials, from the silver plate, which is grown by simultaneous bombarding with argon gas ionsis given in Picture 3.



Picture 3. On diapers made of molybdenum, tantalum and tungsten materials, from silver film, which is grown as a bombardment at the same time with argon gas ions, as a result of thermal heating together with diapers, the spectral graph of the temperature dependence of the separation of argon gas from the film-base system. 1-argon gas, separated from the pure silver film; 2-argon gas, separated from the silver-tantalum system; 3-argon gas, separated from the silver-molybdenum system; 4-argon gas, separated from the silver-tungsten system; V_H -film-base system's speed of heating, $K/сек$; T-the temperature of heating.

As can be seen from the graph, the separation temperature of argon gas from the silver film, which is grown on the bases of the tantalum material, is very close to the separation temperature of argon gas from the pure silver film. In diapers made of molybdenum and tungsten materials, when thermally heated silver films, which are grown as a simultaneous bombardment with argon gas ions, the temperature of the decomposition of argon gas, pure molybdenum and tungsten diapers correspond to the temperature of the decomposition of argon gas. This means that when thermally heated the alloys with the metal compound mentioned above, the temperature at which argon gas is separated from some of them varies. This is due to the fact that when the base material is bombarded with ions, the ions are subjected to a series of cascade collisions with atoms located in areas close to the base surface and surface, on the base crystal lattice. As a result of the interference of atoms or molecules of other substances, numerous, different types of defects, radiation-stimulated diffusion, vacancies, migrations, dislocations occur in the crystal lattice of the base material [6]. In these collisions, due to the fact that ions give their energy to atoms, they settle down in areas close to the surface and surface of the base, in the space (free) areas in the nodes of the crystal lattice, or in the spaces between the lattice (defectors), stop and settle in the crystal lattice. This leads to the fact that the base materials interfere with the atoms of two different impurities in the crystal lattice. In collisions, the energy given by the ions increases the energy of the oscillating motion of the atoms in the crystal lattice, and the atoms radiate this energy in the form of heat. This heat radiation increases the temperature of the crystal lattice. The increase in the temperature of the crystal lattice, change the bonding energies of atoms in the crystal lattice. The increase in the energy of atoms in the crystal lattice, temperature-related vibrations, reduces the energy of interacting between atoms [7].

Inside the crystal lattice, in those areas where the energy of interconnections decreases, atoms can shift from their place, or inside the crystal lattice, moving (migrating) to some part of the lattice . This, in turn, produces a large number of defects in the crystal lattice of the film-base system [8]. These defects lead to a violation of relatively orderly energy connections in the crystal lattice of the film-base system. As a result, a certain part of the atoms in the crystal lattice are silenced or displaced (migrating) from their places. These processes are silences and migrations directed toward the boundary areas of the film-base system touching each other, from the film material, into the base, or into the growing film material from the surface and near the surface of the base [9]. In addition, in these processes, ions of argon gas are also involved. This results in the mixing of three different atoms in the crystal lattice of the film-base system.

As a result, a mixture of the film-base materials in a solid state is formed, that is, a compound alloy of solid bodies is formed [10]. The processes of formation of hard-mixed alloys will depend on the sizes that characterize the physical and chemical properties of the film and base material. To such sizes, film is the energy of surface bonding of atoms of base materials, the energy of bonding of atoms in crystal lattice, the rate of migration of vacancies (migrations) that occur in the crystal lattice of each material, the energy of activation of migration of vacancies, the concentration of vacancies, the concentration of exchange defects, the maximum energy that is transmitted in collisions, coefficients, the depth of the defects formed in the crystal lattice and others are included [11]. For many metals, these sizes were determined in theoretical calculations and found their own confirmation in experiments.

With the help of ion bombardment, it is quite possible to create qualitatively new materials, without breaking the crystal lattice of metal base materials, only by changing its composition. The properties of the surface and areas close to the surface of these new mixed materials have been improved in terms of their physical microstructure, resistance to friction, adhesion, electrical conductivity and chemical–corrosion resistance [12].

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