ISOLATION OF ION BOMBARDMENTS GROWN BY INTRODUCING COMPOUNDS USING MIXTURES DURING THERMAL HEATING OF FILMS AND COATINGS.

Elmurodov Rustam Ummatkulovich, Candidate of Physical and Mathematical Sciences, Associate Professor,
Niyazov Shavki Kulaganovich,Candidate Technical Sciences, Associate Professor, magistr
Ilxom Sayfudinov-Gulistan State University

ABSTRACT. Currently, various methods are used to study the processes occurring on the surface of solids, in particular metals, and in areas close to the surface. In the field of physics, one such method is to grow a film or coating of another metallic material by simultaneously bombarding the surface of a metallic material with gas ions. In films or coatings grown by this method, as well as in the near-surface areas and the base material, the interaction of gas ions, atoms of the film-base material occurs and a carbide system is formed. This suggests that the formation of new phases and chemical compounds occurs in the metal-film-base system. It differs in system parameters, film parameters or base material. The study of changes occurring in the metal film-base system, along with the methods of spectrometry and spectroscopy, is carried out by the method of thermally stimulated desorption (thermodesorption), i.e. thermal heating of the metal film-base system to obtain decomposition spectra from them depending on the heating temperature of impurities.

In this paper, the processes of the release of impurities from films and coatings of silvery material grown on tantalum, molybdenum and tungsten basesbecause of thermal heating bombarded with argon gas ions are studied. The spectra obtained by the thermal desorption method showed that because of ion bombardment, when the atoms of the film and the base material pass from the film to the base material and from the base material to the base material, interference occurs and a hard alloy is formed. The temperatures of the release of impurities from the resulting hard alloys vary.

KEYWORDS: Solids, metals, atoms, molecules, vacuum, ions, ion bombardment, penetration, quantity, surface, near-surface region, crystal lattice, physical, chemical, collision, cascade, relaxation, thermal repulsion, cathode scattering, film, base, film-base system, multicomponent, energy, current, density ion current, ion type, ion dose, interference, energy exchange, hard alloy, structure, concentration, distribution, structural disorders, node, defect, radiation-stimulated diffusion, recombination. Vacancy, migration, dislocation,

mechanical stress, temperature, cascade time, micro rigidity, adhesion, electrical conductivity, corrosion, thermal conductivity.

The object of the study and the methods used.

In the case of water on the crystal lattice of solid bodies or metals, in different ways, it is possible to accelerate the diffusion of foreign gas molecules or atoms of substances in large quantities and at a sufficiently large speed, that is, the penetration of solid objects or metals into the crystal lattice of impurities.

The results and their analysis.

The use of the method of thermostimulated desobtion gives much better results in order to study the change in the properties of the films or coatings of other metal material, which are simultaneously bombarded with ions of inert gases on the metal bases [1].

Using the thermodesorption spectra obtained by this method, it is possible to obtain important information about the processes occurring within the boundaries of the film base system. Based on such data, it is possible to determine the boundary values of the interception and separation temperatures of mixtures introduced into the film base system as ion bombardments, to determine the rate of migration of defects occurring in the film base system, and to determine the approximate values of the degree of mutual interference of film and base materials [2].

For this purpose, from the materials of metals such as silver (Ag), molybdenum (Mo), tantalum (Ta), tungsten (W), diapers with a circle thickness of 20-25 mm, surface 15-17 mm^2 are prepared. Experiments were divided into two types. The first round of experiments was conducted in vacuum conditions, on bombarded diapers with argon gas ions, in which the diapers in the pure state were inert. The second round of experiments was conducted on the film and coatings of silver (Ag) material, which was simultaneously bombarded with argon gas ions on other bases made of the same metal materials. Each base and film - base system separately conducted a current, drawing the spectrum of decomposition (thermodesorption) of mixtures by heating, and these spectra were compared to each other.

In the Figure 1, when the film or coatings are not grown, when heated silver, molybdenum, tantalum and tungsten diapers bombarded with argon gas ions, the speed of separation of impurities from these diapers, the dependence on the heating temperature spectrum lines are given.

With the values in the graph (Fig. 1), it can be seen that the sizes listed in Table 1 [3], the bulk of the mixed gas from the silver, molybdenum, tantalum and tungsten bases are completely separated at temperatures of 900, 1000, 1200 and 1500 K respectively. Such a change in the decomposition of the compound gas will depend on some properties of the base material. The values of the sizes characterizing such properties are presented in Table 1.

The same thing can be observed if the values of the graph are compared, with the increase in the melting temperatures of the base materials, the surface bond energy and sublimation energy increase, while the assessments of the coefficient of decay correspond to this, that is, silver is eaten faster than other metals. Accordingly, the main separation of argon gas from metal bases increases with the value of the temperature limit, the decrease in the coefficient of decay, The melting temperature - the increase in the surface bond energy and heat sublimation of the sine. The mixture, which was introduced as a bombardment, has the property of keeping the ions of argon gas independent, made of tantalum and tungsten materials

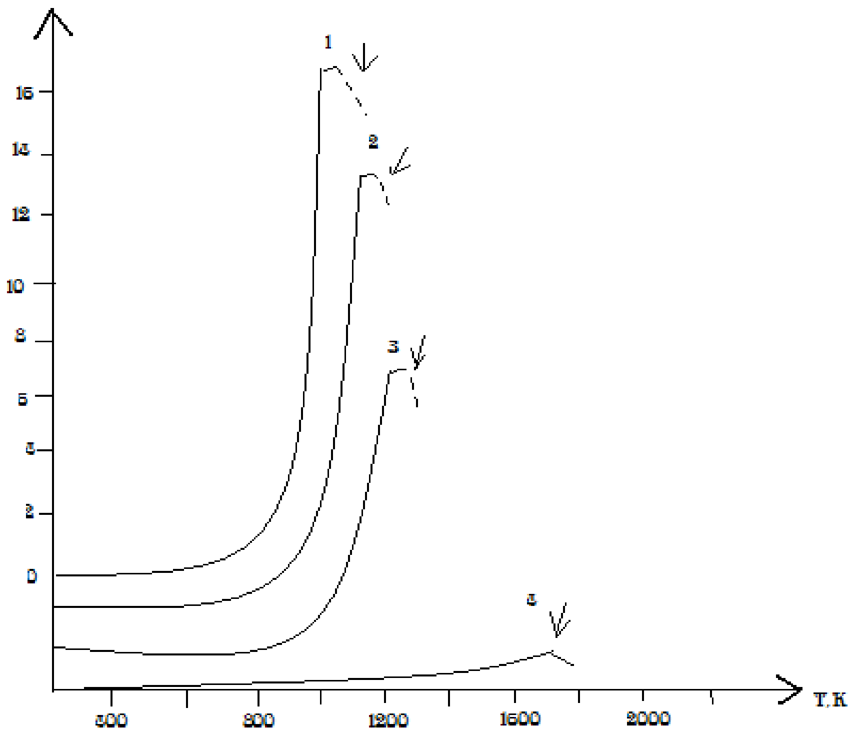

Figure 1. On bases made of molybdenum, tantalum and tungsten materials, from silver plank, which is grown as a simultaneous bombardment with argon gas ions, together with diapers, as a result of thermal heating, the spectral graph of the temperature dependence of the separation of argon gas from the plenca-base system. *1*-argon gas, separated from the pure

silver plank; *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 -heating system of film – base system, $K/сек$; T-the temperature of heating. Temperature dependence of the rate of decomposition of argon gas from pure bases of silver, molybdenum, tantalum and tungsten.

1) Ag, V= 7,3, F=1.0·10^{16}, E= 600 eV. 2) Mo, V=6,3, F=1.3·10^{16}, E= 600 eV. 3) Ta, V = 4,6, F= 1.3·10^{16}, E=600 eV. 4) W, V= 6,3, F=1.2·10^{16}, E= 600 eV. Here V_H is heating speed k/sec F is the dose of bombardment ions, cm^{-2}. T is heating temperature. It is observed in the bases. The decomposition of the main gas mixture is observed at temperatures T~1200K from the tantalum base and T~1500K from the tungsten base. Separation of the main gas mixture occurs at temperatures of T~900K from the silver base and T~1000K from the molybdenum base.

Table 1

No.	**Name of the material**	**Melting temperature, K[3]**	**Surface connection energy, eV[3]**	**Sublimation heat, eV/atom[3]**	**The coefficient of decay, (E=600eV) atomic/ion [3]**
1	Ag	1234	3,0	2,93	2,9
2	Mo	2890	6,8	6,83	1,2
3	Ta	3270	8,7	8,04	1,17
4	W	3650	8,8	8,7	1,08

Figure 2 shows a graph of the main separation spectra of mixed argon gas ions from silver films, which are simultaneously bombarded with argon gas ions on bases made of tantalum, molybdenum and tungsten materials.

These graphs are compared with spectra graphs in Figure 1, it is possible to observe the same thing: the temperature of the decomposition of argon gas mixture from silver films grown on a base made of tantalum material is very close to the temperature of the decomposition of argon gas mixture from the base of pure silver material.

The temperature at which the argon gas mixture is separated from the silver film, grown on diapers made of molybdenum and tungsten materials, corresponds to the temperature at which the argon mixture is separated from the pure molybdenum and tungsten diapers.

With the decomposition temperature of the argon gas mixture from different metal bases, it is observed that in these metals there is a difference in temperatureof the mixtures from silver films, which are grown by bombarding, with argon gas ions. Let's look at the reasons for the occurrence of this difference.

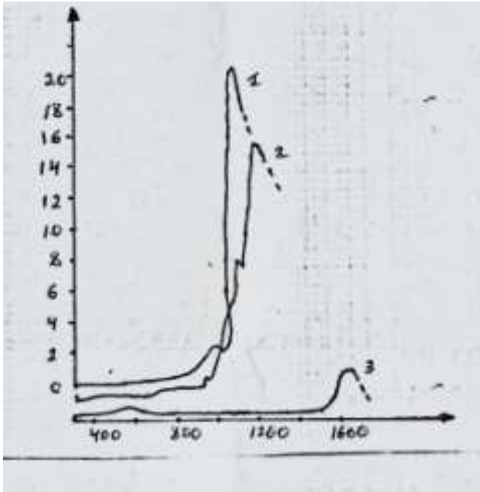

Figure 2. Silver grown on tantalum, molybdenum and tungsten bases heating the rate of decomposition of argon gas from the film dependence on temperature. E=600 eV, V_H-heating speed, K / sec, F-bombardment dose, cm^{-2}. 1) V_H in tantalum=V_H=5,4 F=$1.4 \cdot 10^{16}$.
2) In molybdenum V_H=6,4 F=$1.1 \cdot 10^{16}$. 3) In tungsten V_H=5 F=$1.1 \cdot 10^{16}$.

It is known that the film or coating, which is grown as an ion bombardment, together with the base is a single system, forming a solid alloy with a crystal lattice. The crystal lattice of this alloy will have a more orderly structure than the ordinary one [4].

In addition, as a result of the occurrence of transitions in the vacancies that occur on the account of cathode decays and defects that occur under the influence of ion bombardment, the atoms of the metal base material can grow on the account of cathode decay, the transition of growing film or coatings to crystal lattice, the type of film or coating base material. As a result, the growing film or coatings will remain with the properties that are very close to the properties of the base material. Under the influence of ionized bombardment, the penetration of atoms of film or coatings into the vacancies of defects occurring in the base material may occur [5]. In this case, the film or coatings vaporgrows on the type of film material under which it is poured. Here remains the property of the film-base system, the properties of the film or coating materials [6]. Ion bombardment causes the atoms of film or coating materials to interfere with the base material.

In the film-base system, the interference of atoms of metal materials will depend on the coefficient of cathode decay of these materials and the rate of migration of the vacancies formed in them [7].

On the same basis, as a result of thermal heating from the film–base system, which is formed by a bombardment with argon gas ions, the decomposition of the argon gas mixture is compared with the spectral graphs, the separation temperature of the argon gas mixture from the base made of pure silver material, the temperature of which is higher than T~50 – 100 and these temperature ranges are higher than the melting temperatures of the film or coatings of T~500 – 700K, which are made of silver material. In other words, even after the film or coating materials evaporate as a result of heating, the decomposition of the argon gas mixture from the diapers continues. This means that there is a conclusion that even impurities have penetrated into the diapers. This case can be explained as follows.

Firstly, in the cultivation of film or coatings as a bombardment with ions at a time, the speeds of spatial migration of film or base materials play an important role [7]. If the rate of migration of the growing film material to the vacancy is greater than the rate of migration of the base material to the vacancy, then the transition (interference) of the atoms of the base material to the film material will be greater, that is, the atoms of the base material, the migration of the film material to the crystal lattice. Otherwise, if the speed of the vacancy migration of the base material, that is, the vacancy migration of the film material is greater than the speed of the migration of the base material, the probability of migration of the atoms of the film material to the crystal lattice of the base material will be greater [8].

Secondly, as a result of ion bombardment, solid alloys with a mixture are formed. These solid alloys form a film-compound-base system. In this system, depending on how the film and base materials are selected, the melting temperature of the mixed solid alloys with the dressing may increase or decrease. For example, the samarium (Sm) material included in the magnesium (Mg) material, which reduced the melting temperature of the magnesium material [9].

There may also be a reverse case to this process, that is, when a metal film or coating is grown by simultaneously bombarding the soles made of metal materials with a high melting temperature, the migration of the atoms of the base material to the material of the film occurs, depending on the ratio of the speeds of the migration. This, in turn, when the film-Base system, formed by ionized bombardment, is thermally heated, the separation of mixed gases from this system can increase the temperature limit [10].

When comparing the spectra obtained in experiments with each other in graphs, it is confirmed that the idea is correct, that is, on diapers made of molybdenum and tungsten materials, it is observed that the decomposition temperature of the compound argon gas is higher than the melting temperature of the silver material, which is grown by bombarding with argon gas ions. This indicates an increase in the melting temperature of the material of the film, as a result of the migration of atoms of molybdenum and tungsten materials to the silver film.

This indicates that atoms of metal films and coatings, which simultaneously bombard with inert gas-argon ions, are mixed with atoms of metal bases, and solid alloys with impurities are formed on the boundary on both sides of the film-base system.

REFERENCES

1. Timorev A., Panesh A., Gerichkov M. Termodesorbsiyatomovinertnihgazovizneuporydichennihtverdih tel. M.:jurnal: Poverhnost,fizika, ximiy. mehanika. 2007.–S. 88-104.

2. Balek V., Teldesh Y. Emissionno-termicheskianaliz. M., Mir, 1996.–S. 367.

3. Orlov A. N., Trushin U.V. Energiitochechnixdefektov v metallax. M.: Nauka, 2013. –S. 81.

4. Mett N., Gerni R. Ato‘mnie i elektronnieprotsessi v kristallax M.: Nauka, 2013. –S. 423.

5. Vavilov V.S., Kub E.A. Mexanizm obrazovaniye i migratsiya defektov vmetallax. M.: Energiya, 2009. –S. 175.

6. Pranyavichyus L. U. Modifikatsiyasvoystvtonkixplennokionnmipuchkami. Vilnyus, mokslas, 2016. –S. 240.

7. Tul’ev V. Sostov i raspredeleniekomponentovpoglubine,sformirovannihmetodomionnogoperemeshivaniya. M.:Jurnalfizika iximiyaobrabotkimaterialov. 2009, № 6. –S. 55-65.

8. DevisDj. A., Foti G. Modifitsirovaniye i legirovaniyepoverhnostilazernmi,ionnmi i elektronnmipuchkami M.:Nauka, 2016. –S. 422.

9. Roxlin L.L., Padejnova E.M. Issledovanierastivorimostisamariy vtverdomrastvorenaosnovemagniy. M.: 2018.–S. 101-108.
10. Timofeev A. B. Termodesorbsiyatomovinertnixgazovizneuporyadochennixtverdix tel. M.: 2017.–S. 70-73.