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OF HIGH VOLTAGE SELENIUM ELEMENTS PRODUCTION AND PROSPECTS

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Abstract

In recent years, the deeper study of the electrical properties of bodies by modern physical methods has created new correct ideas about the distribution, release and movement of electrons in solid and liquid bodies. The ability to control the concentration, lifetime, mobility, and motion of free electrons (as well as holes) in a group of solids has made it possible to appropriately change the electrical properties of those bodies as required by technology. This raises electrical engineering to a new stage of development.

It is enough to note that semiconductors can be called the armory of modern electrical engineering, as well as their role in the creation of new scientific and technical fields. By means of semiconductors, an alternating electric current is rectified, a weak current is amplified, the energy of heat, ordinary and radioactive rays is converted into electricity, nuclear particles are counted, a weak electron stream is multiplied, sound energy is converted into electricity and vice versa, cooling is achieved with electricity, catalysis is carried out in a number of chemical reactions, electricity current and voltage are regulated in the lines, complex processes are automated, ferromagnetic metals are replaced in a number of places, etc.

Based on a number of experiments, modern physics confirms that the atom is a complex electrical system consisting of a positively charged nucleus and negatively charged electrons. Electrons move in complex orbits around the nucleus

For semiconductor rectifiers, especially for special selenium rectifiers, the study of thermal conductivity is as important as electrical conductivity. In selenium rectifiers, a small amount of chlorine, bromine or iodine additives are added to the semiconductor in order to reduce the rectification resistance.

Keywords: selenium, radioactive, electrode, ferromagnet, voltage

A proper understanding of the physical processes taking place in Selenium rectifiers allows to improve the characteristics of these rectifiers. The physical basis for improving the characteristics of rectifiers is the creation of a perfect, stable and unaffected p-n junction in them.

Let's mention some methods that allow increasing the working voltage of the selenium rectifier:

1. In cadmium-plated elements, cadmium is applied to the surface of the sulfur-selenium layer by evaporation in a vacuum, and a cadmium-tin alloy is applied on top of it. In this way, relatively flattening the p-n junction, increasing the voltage up to 30v can significantly reduce wear and damage to the mold.

2. Preparation of thallium selenium elements differs from the related technology by mixing 0.015-0.01% thallium in the upper electrode.

In this way, the working voltage increases to 30v. It can be seen that the improvement of the contrast characteristic when thallium is applied to the upper electrode is related to the reduction of conductivity due to the diffusion of thallium in the p region.

Although thallium is a modestly abundant element in the Earth's crust, with an estimated concentration of 0.7 mg/kg, mainly associated with potassium-based minerals in clays, soils, and granites, thallium is generally not economically recoverable from these. The flat resistance of thallium elements is small, but they wear out very quickly at high temperatures. G. A. Akhundov, by applying a layer of TlSe on selenium, managed to obtain high-voltage selenium rectifiers with a mold in a short time.

3. We said above that hard molding consists of applying great stress to the element. If the element is oiled during molding, the operating voltage is greater than 30v. It can be assumed that oil immersion protects the bonding layer from oxygen during molding, heats it homogeneously, and creates a perfect p-n junction.

Oil-moulded elements are resistant to higher stresses. This phenomenon is related to the isolation of the weak places of the binding layer and the lack of oxygen. The relative stability can be explained by the small diffusion of halogens into the p region.

A sharp p-n junction is also obtained with a temperature gradient during molding. Such molding accelerates the formation of the semiconductor and the removal of impurities from the p-n junction by the electric field.

4. When the cell is taken as cathode in acetone with 0.001% brominated cadmium salt before the top electrode is formed, the sample is 30v. Here, the improvement in alignment can be explained as follows.

In an electric field, acetone is partially decomposed and hydrogen is released. Cadmium accumulates on the cathode. The atoms combine with hydrogen selenium to form selenized hydrogen. Current density increases in rough areas of the surface. Selenium hydrogen formation intensity increases. As a result, the surface of selenium becomes flat. When sulfurous hydrogen gas is removed from the surface, the surface becomes bumpy. [2]

In addition, halogen additives (negative ions) migrate from the surface layer of selenium to the liquid by field emission.

When the top electrode is drawn, favorable conditions for molding (flat and doped-free semiconductor surface) are created, resulting in a very flexible and sharp p-n junction. Cathodic processing should be viewed as electrofarming when the top electrode is liquid. Such experiments should be carried out in a vacuum and under different gas conditions.

5. "T" type elements. The process of making them consists of applying cadmium on an aluminum substrate and selenium on top of it.

The upper electrode bismuthed process consists of coating cadmium on an aluminum substrate and selenium on top of it. The upper electrode is made of annealed aluminum. In these elements, a p-n junction is formed on the lining. The effect of moisture is absolutely impossible for that transition and they are resistant to mechanical moisture, their forms are almost indestructible and they have a great future. At low temperatures, the reverse current in these rectifiers increases sharply. This phenomenon can be explained by the disruption of the surface of the p-n junction as a result of the difference in thermal expansion coefficients of the lining and selenium in a certain direction. The effectiveness of molding in these elements is due to the low concentration of additives, the absence of moisture and oxygen, and the binding layer is less deformed during crystallization. This technology allows to make 40v elements. These straighteners can be explained by the reduction of additives.

Thus, a number of practical methods for the improvement technology of selenium rectifiers have been demonstrated and good results are being obtained.

Experiments have shown that if the top electrode of selenium rectifier elements is made transparent to visible light, a photoelectric driving force of up to 0.4-0.5v and a photocurrent of 2-3 ma/cm2 are generated in each of the elements in ordinary sunlight.

A maximum was observed at a wavelength of 5852Ao for both CdSe-Se and CdS-Se.

After electroforming and thermoforming, the value of the photoresist increases sharply, which is related to the improvement of p-n junction and rectification effect. Processes that improve alignment should presumably also improve the valve photoeffect. In addition, since the photoeffect and alignment are formed on the surface of the semiconductor, it is important to treat the surface with various chemical methods to increase the effect.

High voltage selenium rectifiers have been obtained by coating a thin layer of CdSe or CdS on selenium.

One of the interesting issues is the generation of valve electric driving force in the p-n junction under the influence of X-rays. Such an effect can be expected, because the structure of the rectifiers described above corresponds to the structure of valve photocells. The conductivity of electronic semiconductors is about 106 times less than the conductivity of selenium.

In these systems, the n-type semiconductor chemical bonding layer wakes up the pole. In rectifier elements, the electrode to both metals is opaque to light. X-rays are not substantially absorbed as they pass through the electrodes.

Here, we aim to clarify two issues.

1. Does the internal photoeffect occur in artificial p-n junction selenium rectifiers under the influence of X-rays?

2. Does the valve ehr - appear in artificial transition selenium elements under the influence of X-rays?

Selenium rectifier elements prepared by the above-mentioned methods were taken as the research object. The element is precisely shielded from light and placed at a fixed distance from the x-ray tube window. When the current passing through the sample is low, it is measured by a mirror galvanometer with an internal resistance of 161 ohms and a sensitivity of 1000 mm/ma, and when it is high, it is measured by a milliammeter.

As a source of X-rays, a molybdenum anti-cathode BSV-4 tube was taken. The accelerating potential from the X-ray tube was changed from 30 kV to 55 kV and the emission current from 2 ma to 30 ma. [1] .

Experiments have shown that the conductivity of the p-n junction increases under the influence of X-rays, its value depends on the accelerating potential, emission current and voltage applied to the sample.

At constant voltage and emission current, with the increase of the accelerating potential, the photocurrent increases first rapidly, and then slowly, approaching a certain constant.

As the emission current increases, the photocurrent acceleration voltage dependence curves change their position without changing their shape. Sample No. 2 shows the ratio of the photocurrent to the current in the dark as a function of the driving potential at 30 *ev* application to the sample and at different emission currents. Apparently, cut the photocurrent up to 45 *ev* already. When the emission current is 20 ma, it is 2-2.5 times more than the photocurrent.

The dependence curves of photocurrent to current in the dark at a bias voltage of 30v and emission current in different acceleration fields show that as the emission current increases, so does the photocurrent. The higher the accelerating voltage, the more sharply the photocurrent increases. In elements, the internal photoeffect occurs in the p-n junction, not in the thickness of selenium.

This is confirmed by the fact that no change in the current through the element was felt when a voltage was applied in the emitter direction and the sample was irradiated.

In pure crystalline selenium, an internal photoeffect occurs under the influence of X-rays, but in the sample we have studied, due to the addition of bromine to the thickness of selenium, its conductivity has increased by two orders of magnitude.

Figure 1 shows the dependence curves of the valve current on the acceleration voltage at different values of the emission current. Here, the acceleration potential in kilowatts is shown on the abscissa axis, and the valve current value is shown on the ordinate axis. As the accelerating voltage increases, the photocurrent also increases. As for the dependence of the photocurrent on the emission current, as the emission current increases, the photocurrent also increases at different accelerating voltages. The dependence of the photocurrent on the emission current becomes even sharper when the accelerating voltage increase.

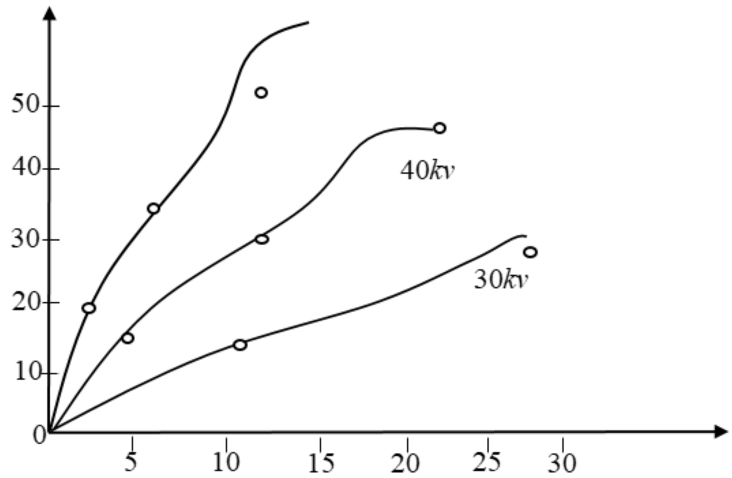


Figure 1. Photocurrent at different emission currents dependence of the ratio of the current in the dark on the displacement voltage

Curves of dependence of the photocurrent on the emission current for element 1 at different accelerating voltages are shown in Fig. 2. The emission current is shown on the abscissa axis, and the photocurrent is shown on the ordinate axis. These results can be explained as follows.

Internal photoeffect in selenium rectifiers is related to the enrichment of free charge carriers under the influence of X-rays of the physical binding layer, either with holes or with electrons.

In the straight direction, the p-n junction is broken, an electronic field is created, and the increase in the concentration of charge carriers does not play a role in the change in conductivity. Due to the development of the bonding layer in the p-n junction, the conductivity of the system in the bonding direction decreases several times.

An increase in the concentration of carriers in the p-n junction under the influence of X-rays leads to an increase in the current.

Photocurrent increases with increasing accelerating voltage. This is explained by the fact that as the energy of X-ray quanta increases, the number of electrons that are removed also increases. In a semiconductor, electrons are stripped from additional atoms and base ions.

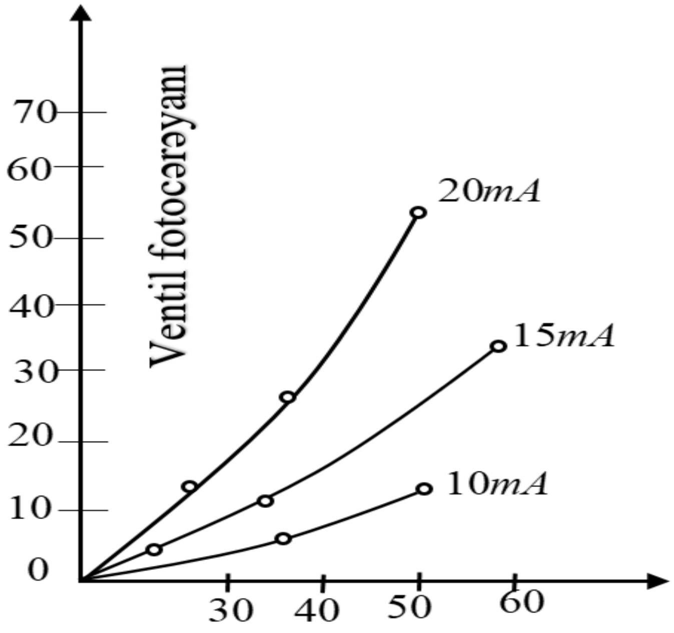
Under the influence of X-ray quanta, electrons move from additional levels and from the filled band to the empty band in electron-hole semiconductors. In this case, the concentration of electrons in the empty band and holes in the filled band increases, which leads to an increase in conductivity.

The concentration of bound electrons in additives and in the filled band increases depending on the upper limit. In excess of the accelerating voltage, the electrons from the deepest X-ray quanta can be freed. As the emission current increases, the number of released electrons also increases, which is a condition for increasing the conductivity of the p-n junction.

As for the increase of the valve photoeffect, it can be explained as follows. When X-rays affect the p-n transition, the dynamic balance of thermal electrons in the system is disturbed.

Electronic transitions between dopant levels and bands cannot cause a valve effect, because in this case the amount of charges in a semiconductor remains constant. [2].

X-ray quanta knock electrons out of the bandgap of an electron-emitting semiconductor and move them into the conduction band. The free electrons move to the metal, making it negatively charged. The electrons of the filled band of selenium move to the vacancies (holes) in the electron-bearing semiconductor, resulting in the positive charge of the selenium and thus the bottom electrode.



Accelerating voltage

Figure 2. At different value of emission current photocurrent accelerating voltage dependence curves

The effect of X-rays on the conductivity of the p-n junction in the dynamic mode and at different temperatures was also studied. The change in conductivity was judged by the change in the pattern of the reverse current in the electronic oscillograph.

Apparently, the irradiation of celene rectifiers with X-rays in the dynamic mode of the rectifiers causes a sharp increase in the reverse current.

At the same voltage (30v), but at different temperatures (+20 and -180oC), the effect of X-rays on the increase of reverse current varies. At low temperatures, the strong field effect dominates over other factors, so the effect of X-rays is weakened. M.A.Talibi studied the effect of gamma rays on artificial p-n junction selenium rectifiers prepared by the above method. Samples with good alignment property and sensitive to X-rays were prepared for the experiment.

As a radiation source, a radioactive isotope of cobalt with a half-life of 5.27 years was used. The radiation of the indicated isotope consists of gamma quanta of 1.313 Mev and beta particles of 0.318 Mev. Additional filters were taken to protect the studied samples from beta particles. [3].

During the experiments, the activity of the source was close to three Curies.

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