

PHYSICAL SCIENCES

STATIC VOLTAGE CHARACTERISTICS OF HIGH VOLTAGE ELEMENTS

Aygun Sultanova Haji gizi

PhD in Physics, docent

Nakhchivan Institute of Teachers

ХАРАКТЕРИСТИКИ СТАТИЧЕСКОГО НАПРЯЖЕНИЯ ЭЛЕМЕНТОВ ВЫСОКОГО НАПРЯЖЕНИЯ

Айгюн Султанова Гаджи кызы

Кандидат физических наук, доцент

Нахчыванский Педагогический Институт

Abstract

Selenium has good photovoltaic and photoconductive properties, and it is widely used in electronics such as photocells, photometers, and solar cells. The second largest use of selenium is in the glass industry: selenium is used to remove color from glass, and to give a red color to glasses and enamels. A third minute use is sodium selenite for animal feed and food additives, taking about 15%. Selenium can also be used in photocopying and toning of photographs. Its artistic use is to enhance and expand the tonal range of black and white photographic images. Other uses of selenium are in metal alloys such as lead plates used in battery cells and rectifiers to convert AC current to DC current.

Аннотация

Селен обладает хорошими фотоэлектрическими и фотопроводящими свойствами и широко используется в электронике, такой как фотоэлементы, фотометры и солнечные элементы. Второе место по объему использования селена занимает стекольная промышленность: селен используется для обесцвечивания стекла и придания красного цвета стеклу и эмали. На третьей минуте используется селенит натрия для кормов для животных и пищевых добавок, занимающий около 15%. Селен также можно использовать при фотокопировании и тонировании фотографий. Его художественное применение заключается в усилении и расширении тонового диапазона черно-белых фотографических изображений. Селен также используется в металлических сплавах, таких как свинцовые пластины, используемые в аккумуляторных элементах и выпрямителях для преобразования переменного тока в постоянный.

Keywords: photoconductor, range, voltage, additive, concentration.

Ключевые слова: фотопроводник, диапазон, напряжение, добавка, концентрация.

Selenium is used to increase wear resistance in vulcanized rubbers. Some selenium compounds are added to anti-dandruff shampoos.

Temperature and voltage that lead to linear dependence of $\lg R$ on U^2 for different samples with the same thickness of n semiconductor depend on the amount of halogens in selenium. When the concentration of additives is low, the temperature is low and the voltage is high.

The study of the voltage dependences of the capacitance of both conventional selenium elements and artificial layered samples showed that the sharper the change in capacitance when changing the direction of the displacement stress, the better the element.

The efficiency of rectification depends on the electrical flexibility of the bonding layer. The correctness of such a relationship was also confirmed on high-selenium elements with an artificial pn junction. Fig. 1 shows the displacement voltage dependence curves of the capacity of three high-voltage samples at room temperature. In the 1st and 2nd samples, CdSe 3rd elements and the element has a CdS

artificial layer. These elements have a normal resistance and work at a reverse voltage of 55 V. [1].

It can be seen from the figure that when changing the direction of the field, the change in capacitance is sharper than in low-voltage selenium cells. This change shows that the bonding layer in high-voltage elements is very sensitive to the influence of the external electric field, that is, it has great flexibility. The explanation is as follows.

In high-voltage elements, the concentration of halogen additives decreases in the holed part of the pn junction. Under the influence of the reverse voltage, the already low concentration of holes in the sufficiently thick contact layer of selenium is further reduced. As a result, the capacity of the element decreases.

For high-voltage selenium elements, the capacitance at 5 c in the junction direction is 10 times less than that at 0.1 v in the flat direction [2]. Regarding the temperature dependence of the capacity of high-voltage selenium cells, as in conventional cells, the capacity at small displacement voltages increases sharply with increasing temperature.

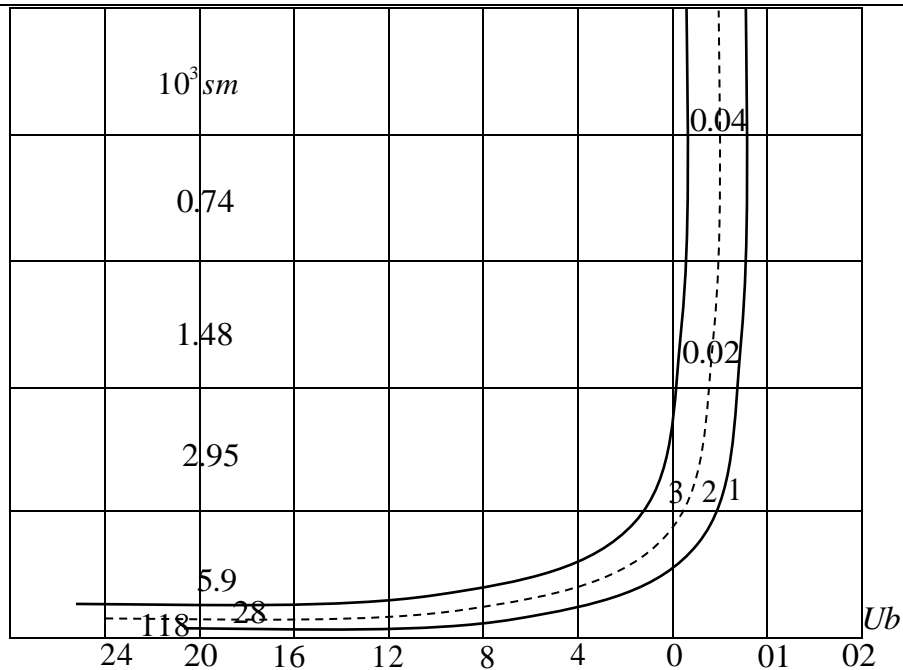


Figure 1 . From the capacitance displacement voltage of high-voltage elements dependence l-CdS sample No. 2 ; 2 - CdS sample No. 3 ; 3 -CdS sample).

When the voltage is more than 5-6 v , the capacity does not depend experimentally on the temperature. This is due to the limit value of the residual of the binding layer in the *n* semiconductor. In this case, the

entire residue of CdS or CdSe is covered by a physical bonding layer. In selenium, the physical binding layer extends to the boundary.

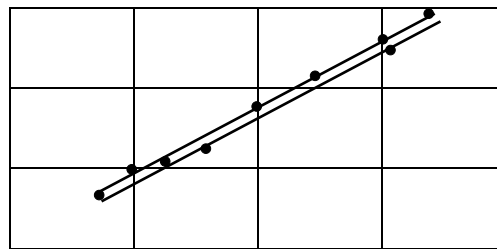


Figure 2 . Adjusted for high-voltage sample with cadmium-sulphide layer dependence of the average value of current and voltage on the input voltage

Relatively sharp dependence of capacitance on temperature is obtained at positive displacement voltages. Here, the temperature dependence of the capacitance at different displacement voltages for CdSe layered samples is given [2].

The sharp change of capacitance depending on temperature in positive displacements can be explained as follows.

At these voltages, the junction layer is thin, and it has the ability to expand in either a hole or electron

semiconductor. Therefore, if the binding layer is thin, the reserve area for its expansion is large, as a result, the layer can expand sharply with a drop in temperature during positive displacements.

The dependence of the average value of the rectified current and voltage on the input voltage for a high-voltage cell with a cadmium-sulfide layer is given in Figure 2.

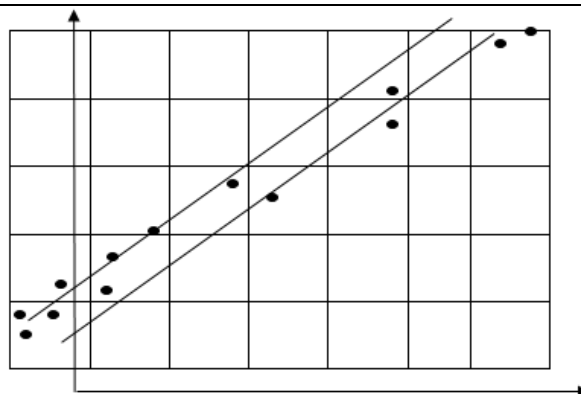


Figure 3 . Adjusted for high-voltage pattern with cadmium-selenide layer dependence of the average value of current and voltage on the input voltage

Conventional selenium cells provide rectification of 25 ma/cm^2 and 7 v (average value) in a single-phase alternating current circuit at 18 v alternating current . (picture 3). At the nominal value of the current of the high-voltage elements (25 ma/cm^2), an effective input voltage of $40\text{-}60 \text{ v}$ gives an average rectified voltage of $20\text{-}25 \text{ v}$ [2].

The working area of the sample is 11.45 cm^2 . The single-phase measurement was carried out according to the periodic scheme. It can be seen from these graphs that I_d , and U_d increase in a straight line with the increase of the applied voltage (U_{eff}). At nominal current and $U_{eff}=65 \text{ v}$, the rectified voltage increases to 27 v . The temperature of the sample reaches about 45°C for two hours during operation .

The dependence of the rectified voltage on the current in the working resistance at different values of the applied voltage shows that U_d As I_d increases to the nominal value (300 mA), it remains experimentally stable. In order to study the characteristics of high-voltage selenium cells on a single-phase two-half-cycle scheme, two element rectifier bridges are assembled on each side. The working area of each sample is equal to 11.45 cm^2 .

The short circuit consists of direct connection of the top electrode with the substrate. This occurs when the cathode is drawn and also during molding. When the upper electrode is pulled, the reason for the short circuit is that there are dips in the selenium.

Experiments have shown that depressions in selenium are formed during crystallization.

It can be seen that the formation of sinkholes is related to the release of absorbed gases. This phenomenon disappears when the primer is heated for a long time in a good vacuum. A short circuit in an electrical mold is observed in those elements that were initially short circuited.

The probability of a short circuit increases as the temperature increases and the thickness of the selenium decreases. This situation can be explained by the increase in the diffusion of metal atoms between the crystals.

The molding of molded selenium elements breaks down during long periods of non-operation and under small operating stresses. This event changes the mode of operation in a number of schemes.

At this time, the conductivity and capacity of the binding layer increases.

It can be assumed that the distortion of the additive selenium rectifiers is the result of diffusion of halogens to the p region and chemical decomposition in the n region.

Since there is a concentration gradient of additives in selenium, the halogen additives diffuse over time, reducing the resistance of the switch.

Diffusion, and thus the process of mold failure, should occur faster at high temperatures and when the additive is high, which is observed in the experiment.

Halogen ions are negatively charged, so they must move toward the anode in an electric field.

The amount of additives decreases when taking a halogen sample as a cathode in the electrolyte and passing current. This changes the resistance of the sample in both directions [3].

Indeed, experience shows that if two electrodes (one platinum, and the other a sample of selenium without the upper electrode after the second crystallization) are placed in acetone, halogens are released in the electrolyte, and the resistance of the element increases 3-4 times. In such cathodic processing, the separation of bromine has been demonstrated with radioactive atoms at a convincing rate.

When changing the direction of the external field, bromine and chlorine do not separate, as well as the resistance of the element does not change.

It can be assumed that the deformation process in doped selenium elements is mainly related to the diffusion of halogen atoms and ions in the region of the binding layer. By applying a reverse voltage, it is possible to remove them from the pn junction region and restore the resistance of this layer for a certain period of time.

Form failure in selenium elements without halogen addition is related to the chemical change of CdS or CdSe and selenium in the semiconductor medium . It can be assumed that if there are stable metal additives instead of halogen additives in the selenium layer, the deformation of the mold will be minimized due to their diffusion. The molding of such elements should not be disturbed for a long time. Practically, this can be obtained in two ways:

1) by applying halogenated selenium to the primer and pure selenium on top of it. At this time, in order to reduce the diffusion, it is necessary to draw the second layer on the crystallized selenium and heat it to 214 °C;

2) long-term thermal treatment of selenium samples at 214 °C, adding metal additives to selenium in the form of chemical compounds by reducing the amount of chlorine, bromine or iodine on the surface of the semiconductor can also give interesting results.

Electronographic studies have shown very clearly that as soon as the top electrode is removed from cadmium or its alloys in selenium elements, *CdSe* is formed, and *CdS* is formed in the case of sulphurized selenium elements [3].

Moisture and air pass to the upper electrode of technical selenium elements. Therefore, it is necessary to look at the possible consequences of the interaction of *CdS* (or *CdSe*) with moisture and air.

CdS is known to oxidize, albeit slowly, even at room temperature. This process is greatly accelerated in the presence of moisture. Due to the small thickness of *n* semiconductor, this creates favorable conditions for its combination with oxygen.

The metallicity resulting from the first and second reactions is easily oxidized until cadmium-oxide is formed, SO_2 combines with the moisture of the air and turns into sulfuric acid.

As sulfuric acid is formed, *CdS* and *CdO* decompose, converting $CdSO_4$ to H_2O and H_2S .

Thus, the oxidation of *CdS* by the upper electrode is caused by a decrease in the resistance of the layer in the opposite direction, so that *CdS* is a good conductive medium, which is formed, so that *CdO* is a good conductive medium, and the resulting salts are well soluble in solutions and dissociate, turning into an electrolyte. This is the essence of breaking the mold.

This phenomenon is observed by the formation of a conductive medium whose main cation is cadmium. Such a system should also work as a galvanic cell.

The reaction of tetrachlorine selenium with moisture of water and air plays a key role in the processes of molding failure, wear and short circuit. The same can be said about the addition of bromine.

The phenomenon of self-short circuit in selenium elements consists in the formation of conductive bridges between the upper and lower electrodes, which sharply reduces the reverse resistance.

Selenium rectifiers behave as a galvanic source, that is, when connected directly to a galvanometer at room temperature, current is observed. The polarity is such that the electrons are observed to flow. The polarity is such that the electrons move from the top electrode to the bottom electrode. This phenomenon was observed for the first time in 1943 by D.N.Nasledov and E.K.Malyshev. These authors hypothesized about the galvanic course of the effect.

The formation of a special EHQ in selenium elements is the result of the processes in the region of the connecting layer, and it is related to this in the case of a short circuit.

In all studied samples, the effect of water vapor increased *ehg* by about 30 times. In samples placed in

a vacuum, *ehg* is gradually lost. In *CdS* or *CdSe* elements located between the lining and selenium, no *ehg* is observed when the sample is exposed to water vapor. All these empirical evidences can be explained as follows.

Voltage of the selenium rectifier is the result of the formation of the galvanic element. In that element, the electrolytic solubility of 2 electrodes - selenium and cadmium (or cadmium-tin alloy) - is different.

Here, the electrolyte consists of the product obtained from the interaction of *CdS* or *CdSe* with moisture and oxygen.

As the temperature rises, the sharp increase in *ehz* is explained by the growth of ion mobility and dissociation rate. The decrease of *ehg* over time at a constant high temperature is the result of drying of the electrolyte. This process also occurs in electric molding.

It is explained by the increase of *ehz* or dissociation of *CdS* due to the influence of water vapor and the structure of the electrolyte. In elements with the upper electrode of gold and bismuth, the formation of *ehq* is related to the formation of *CdS* and thus the cadmium-sulfate solution.

Under favorable conditions, the development of the galvanic process creates cadmium conductive bridges in separate places, which causes a short circuit to itself. Based on all this, changes in the parameters of the rectifier and polarization phenomena are observed in those elements due to the influence of moisture. The described events confirm that selenium rectifiers are special galvanic elements, the processes in them lead to the breakdown of the mold and short circuit. Since the formation of the galvanic element is partly due to the entry of moisture into the rectifier, it is necessary to isolate selenium elements from the influence of moist air.

Conclusion

1. High-bolt selenium rectifiers were obtained by coating thin layers of *CdSe* and *CdS* on selenium.
2. In selenium elements, the phenomenon of short-circuiting consists in the formation of conductive bridges between the upper and lower electrodes, which sharply reduces the reverse resistance.
3. In high-voltage elements, the bonding layer is very sensitive to the influence of an external electric field. That is, it has great flexibility.

Literature

1. Akhundov QA Wire conductors. Baku, 1966.
2. Abdullayev HB Selenium rectifiers. Baku, 1956
3. Zarbaliyev MM Physics of semiconductors. Baku-2008. p. 454.
4. Humbatov RT "Electronics" Part I. Baku, "Maarif" publishing house. 2002.
5. Abbasov VM. Taghiyeva AM, Hasanov Z.A., Salmanzadeh Sh.V. Chemistry and Life Baku. "Kovsar". 2011 p. 234.