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Вплив конструкції напівпровідникового діода на його розігрів імпульсом ударного струму

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Influence of design of semiconductor diode of the heating by the impact current

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В роботі розглянуто вплив різних конструкцій виводів напівпровідникових діодів на тепловідвід. Запропоновано, який вид виводів краще за все використовувати для ефективного відводу тепла і відповідно меншого розігріву кристала напівпровідникового діода. Досліджувалися промислові кремнієві напівпровідникові діоди з однаковими характеристиками, але з різними типами конструкцій. Показано, що виводи діодів типу «цвях» краще виконують функцію тепловідводу ніж виводи інших типів.

Ключові слова: напівпровідниковий діод, розігрів, виводи діодів

During the semiconductor diode's life there are many times of creating powerful current. It can be a short circuit or network congestion etc. When the powerful shock pulse passing through a semiconductor diode current is significant heating of the crystal diode, leading to irreversible changes of characteristics. In industry using various types of terminals for different diodes. The paper considers the influence of different designs terminals to diode heat sink. In conducting research through the crystal semiconductor diode missed several half-sine series of current pulses with duration of reheating I_h 10 ms and a frequency of 100 Hz with adjustable amplitude. Proposed kind of outputs is the better used for efficient heat dissipation and consequently lower warm-crystal semiconductor diode. Investigated industrial silicon semiconductor diodes with the same characteristics, but with different type of designs. It was shown that the diodes outputs of the "nail" function better heat dissipation than other types of outputs.

Key Words: semiconductor diode, heating, designs terminals

Статтю представив д.ф.-м.н., проф. Скришевський В.А.

Introduction

When passing through a semiconductor diode powerful shock pulse current is significant heating of the crystal diode, leading to irreversible changes of characteristics [1]. In industry using various types of terminals for different diodes. The aim of this work was to study the impact of design leads to heating of semiconductor diodes.

In [2] have investigated the temperature dependence of the crystal pads on the amplitude and duration of the current pulse and calculated the temperature of heating of the crystal. The value of a warming area p-n junction diode of the crystal during the passage of the pulse was not experimentally determined.

Research methodology

In conducting research through the crystal semiconductor diode missed several half-sine series of current pulses with duration of reheating I_h 10 ms and a frequency of 100 Hz with adjustable amplitude. The number of pulses in the series could change. Along with the current warm I_h diode passed through the crystal constant direct current I_d, value of 10 mA.

There was oscillograms voltage drop across the crystal of the two currents (Fig. 2). For the time when the current warm- Ip was built maximum current-voltage characteristics (CVC) was calculated and its resistance R p. At a time when $I_h = 0$, the voltage drop measured directly from U_d current I_d

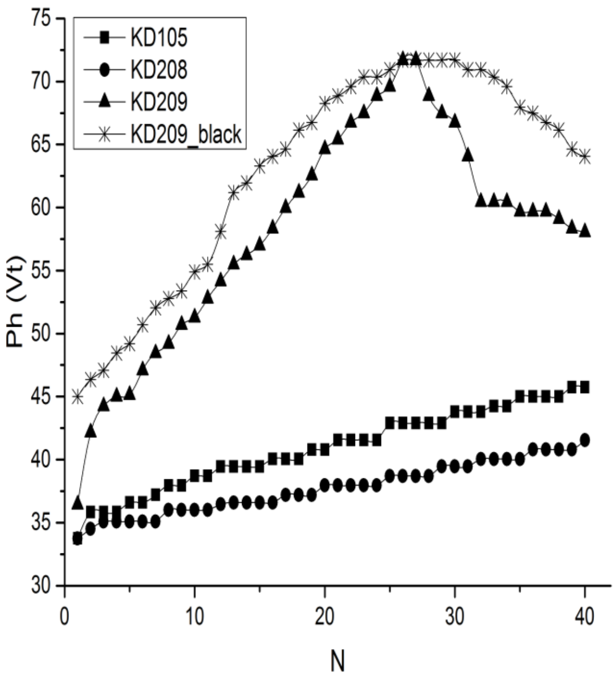

Fig.1 Dependence of diode power allocated to the number of half-waves.

and calculated dependence of resistance of the crystal diode R_d on the temperature and the number of pulses of shock current. The dependence of the voltage U_d direct or R_d on diode temperature T at low forward current I_d, U_d = f (T), the temperature coefficient of the voltage [3] will determine the temperature of the p-n junction.

Experimental samples

To obtain the dependence U_d (R_d) = f (T), the temperature and time used a warm-up tool. A special incubator under an inert atmosphere of nitrogen determined depending U_d (Rd)), the temperature T. By experimentally removed such dependencies defined temperature values at different times of the process of heating.

U_d dependence on temperature is almost linear in the range studied up to 300 ˚C temperature and is applicable for all cases examined.

It should be noted that the exact value of T can be determined only on the graduated crystals. Crystal, more or less heated unevenly, depending on the time of its heating and so any way to determine some average temperature.

On non-graduated crystals can't accurately determine the temperature. It is determined with an accuracy matches the estimated or average depending U_d, with the actual temperature. The maximum error in this case can reach 27%.

Since the research used many crystal diodes are

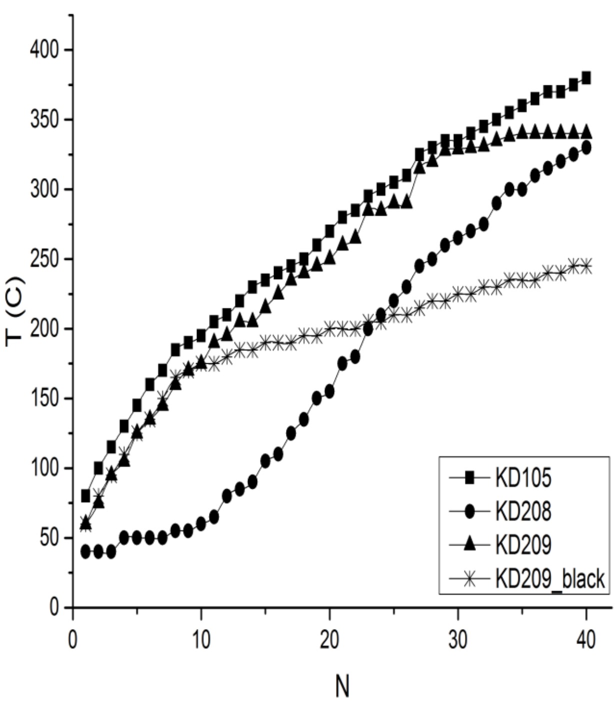

Fig.2 Dependence of the temperature of heating of the diode on the number of half-waves

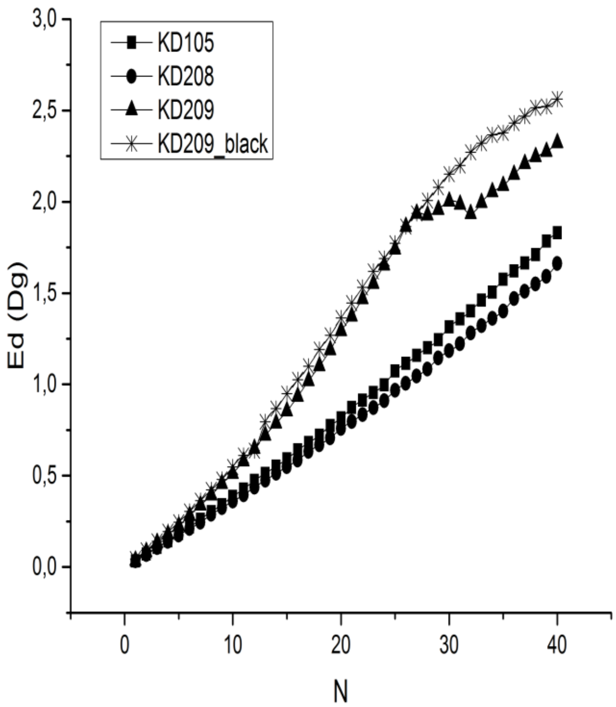

Fig.3 Dependence of the direct energy of diode allocated to the number of half-waves.

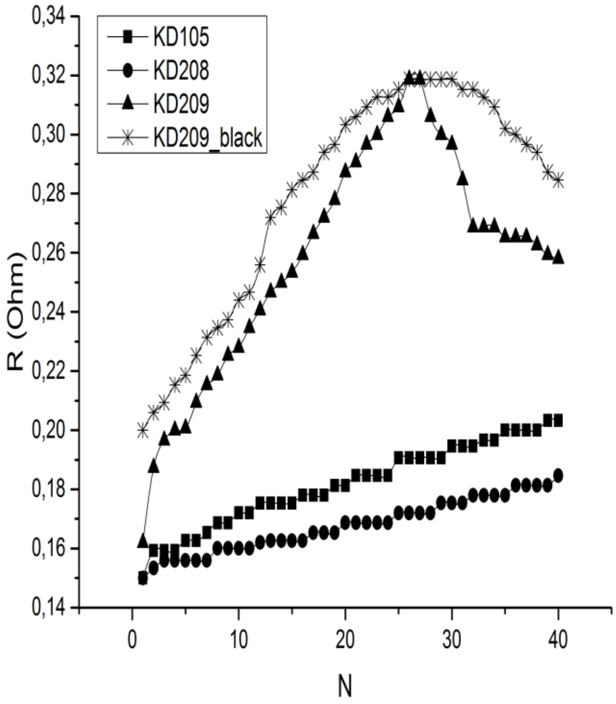

Fig.4 Dependence of the resist of diode allocated to the number of half-waves.

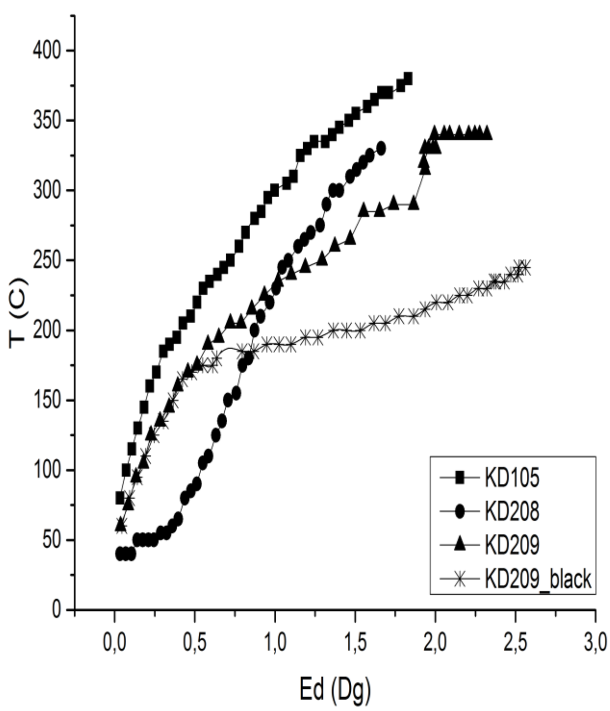

Fig.5 Dependence of the temperature of diode allocated to the direct energy.

shown in the graphs are the most typical averaged results.

The experimental results. In conducting of research results obtained are shown in Figures.

On the figure 1 we can see dependence of diode power allocated to the number of half-waves. We can see that the power allocated on the diodes KD 209 and KD 209 black are largest that power allocated on diodes KD 105 and KD 208.

On the figure 2 shown dependence of the temperature of heating of the diode on the number of half-waves. We can see that all diodes are heating very fast. KD 208 heating more slowly that another. Diode KD209black have temperature maximum of 250 degree of Celsius. So we can say that diode KD 209black is better that another.

On the figure 3 we can see dependence of the direct energy of diode allocated to number of half-waves. We can see that the direct energy on different diodes are growing up different. The largest growing are in diodes KD 209 and KD 209black. And the smaller are in diodes KD 105 and KD 208.

On the figure 4 we can see dependence of the resist of the diode allocated to number of half-waves. We can see that resists on the diodes KD 209 and KD 209black are changing more quick and different. Resists on the diodes Kd105 and KD 208 are changing more slowly.

On the figure 5 we can see the dependence of the temperature of diodes allocated to the direct energy. It is the main figure. On this figure we can see that if we change the direct energy, temperature on different types of diodes changes different we can see that the highest temperature we have on diode KD 105 and the smaller temperature on the diode KD 209black. So we can say that diode KD 209 have more effective construction that another types of diodes.

To obtain the dependence U_d (R_d) = f (T), the temperature and time used a warm-up tool. A special incubator under an inert atmosphere of nitrogen determined depending U_d (Rd)), the temperature T. Since the research used many crystal diodes are shown in the graphs are the most typical averaged results.

Discussion of the results

Crystals with specially filmed dependencies U_d, the temperature called graded.

It should be noted that the determination of the temperature dependence on U_d = f (T) has a limit of measurement accuracy in land temperatures over 400˚C.

The slope of the linear part of this dependence is approximately 2mV/degree. Variations in U_d

graduated crystals did not exceed 15% of the reference data.

Conclusions

Apparently the largest capacity allocated diode KD209 KD209black at the same time as warming KD209 black is much smaller than the KD 209. Possible to conclude that the findings are used in diode KD209 black exercise is more effective than a heat sink diode KD209.

Список використаних джерел

1. *Зи С.* Физика полупроводниковых приборов : пер. с англ. / С. Зи. - Москва: Мир, 1984. - 95с.
2. *Викулин И.М.* Физика полупроводниковых приборов / И.М. Викулин, В.И. Стафеев. − Москва: Радио и связь, 1990. - 264с.
3. *Григорьев О.П* Диоды: Справочник. / О.П. Григорьев, В.Н. Замятин, Б.В. Кондратьев, С.Л. Пожидаев; − Москва: Радио и связь, 1990. - 336с.
4. *Павлюк С.* Вплив температури на модифікацію параметрів діодів потужним імпульсом струму. / С. Павлюк, Р. Кузьмич // Вісник Київського університету. − Сер.: Радіофізика та електроніка". - 2011. − №14. - С. 34-37.
5. *Павлюк С.* Визначення температури діодного кристала під час проходження крізь нього імпульсу ударного струму: / С. Павлюк, Г. Кутлін, С. Савицький, Р. Солтис, І. Тищенко // Вісник Київського університету. − Сер.: Радіофізика та електроніка". - 2008. − №11. - С. 29-32.
6. *Павлюк С.* Саморегуляція виділеної потужності напівпровідникового діодного кристала / С.П. Павлюк, Л.В. Іщук, В.М. Кисліцин // Вісник Київського університету. −Сер.: Фізико-математичні науки, 2002. – №1. - С. 344-347.
7. Диоды полупроводниковые. Термины, определения и буквенные обозначения параметров: ГОСТ 25529–82. − [Чинний від 1984-01-01]. −М.: Изд-во стандартов, 1987. С. 27.

References

1. SZE S. (1986) *Physic of semiconductor devises*. Moskva: Mir.
2. VAKULIN I., STAFEEV V. (1990) *Physic of semiconductor devises*. Moskva: Radio i svyaz'.
3. GRIGOR'EV O. et al. (1990) *Dioes: manual*. Moskva: Radio i svyaz'.
4. PAVLIUK S., KUZMYCH R. (2011). Impact of temperature to modification of diode's parameters of powerful current pulse *Bulletin Taras Shevchenko National University of Kyiv. Radiophusics and electronics* 14. p. 34-37.
5. PAVLIUK S., KUTLIN G., SAVITSKY S., SOLYUS R., TISCHENKO A. (2008) Determination of the crystal diode temperature during the passage through it of shock pulse current *Bulletin Taras Shevchenko National University of Kyiv. Radiophusics and electronics* 11. p. 29-32.
6. PAVLIUK S., ISCHUK L., KYSLITSYN V. (2002) Self-selected power semiconductor diode crystal. *Bulletin Taras Shevchenko National University of Kyiv. Physical and Mathematical Sciences* 1. p. 344-347.
7. GOST 25529-82 (1987) Semiconductor diodes. Terms, definition and letter options of parameters. p. 27.

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