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EFFICIENCY OF THERMOELECTRIC GENERATORS MODULE METHODS OF INCREASE

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Abstract:	Keyword
It is known that many scientists are currently conducting a lot of research on the development of energy obtained in an ecologically clean way. In this regard, thermoelectric generators that convert heat directly into electricity are also of particular importance. The advantage of thermoelectric generators is that the device does not require any moving and frictional parts, high pressure conditions and specific situations. They are long-lasting and require no maintenance. The disadvantage is its extremely low F.I.K value (0.8~1%).	

Introduction

In today's conditions, as the lighting system improves and the consumption of light diodes, which consume less energy instead of incandescent lamps, increases, the demand for thermoelectric generators is increasing again.

The essence of thermoelectricity, that is, the Seebeck effect, is that the junctions in a closed circuit made of two different conductors or semiconductors are differently

if kept at temperature, heat ЕЙуК - occurs in the circuit. The generated EIUK depends only on the internal properties of the conductor (semiconductor) materials and the difference between hot T1 and cold T2 temperatures at their junctions.

TermoEYuK value can be written in a small temperature range as follows

$$\varepsilon = \alpha_{12} (T_1 - T_2)$$

Here α - is the coefficient of thermo electric power.

The reasons for the formation of EYUK consist of several parts, which can be explained as follows;

1) As the average energy of electrons in different substances depends on the temperature, electrons begin to pass from the hot end to the cold part, and the negative potential is created by the increase of electrons on the cold side, and the positive potential is formed on the hot end. The potential field in which the flow of electrons is formed begins to show resistance, and when they equalize each other, the flow stops and an internal EDUC is formed.

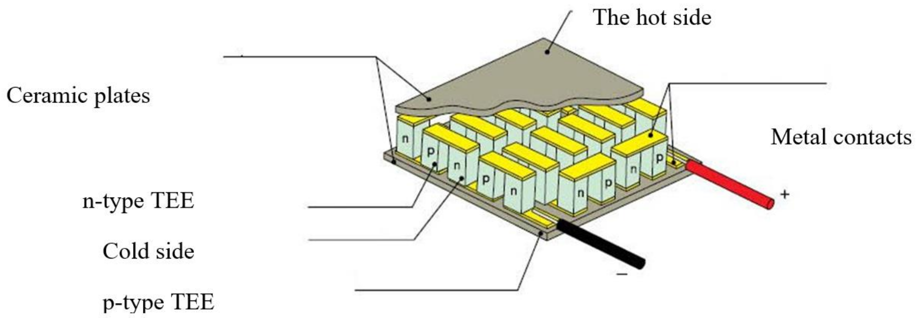
2) A contact that occurs when conductors with different output functions are connected potential difference

$$eU = F_2 - F_1$$

due to potential difference. When the circuit is closed, if there is no temperature difference, the potential difference at both junctions is the same, and the resulting electric power is equal to zero. If there is a difference in temperature, an electric power occurs and it is called a junction electric power.

1) Electric power caused by phonon tracking. The vibration of the nodes of the crystal lattice can be considered as the vibration of quantum particles - phonons - oscillating at the frequency of sound. If a temperature gradient occurs in a solid body, the number of phonons moving from hot to cold begins to increase. They can collide with electrons and take them with them. As a result, electrons increase in the cold part and negative potential increases, while in the hot part it becomes positive.

This difference in potentials also leads to an increase in the total value of the EC. We can see that the mechanism of formation of electric power in case of temperature difference depends on many parameters. The module of thermoelectric generators created on the basis of such mechanisms can be as follows.



To increase the useful work coefficient, it is necessary to increase the difference between the heat energy supplied to the heated and cooled sides Q_t and removed Q_c. Electric power is proportional to the square of the temperature difference.

$$P = Q_L - Q_C \approx J^2 R_n \sim \Delta T^2$$

We see that if the temperature difference and the number of thermocouples in the module are chosen sufficiently, it is possible to have a source of electricity that is used efficiently in the lighting system. In fact, using thermoelectric generators instead of fast-draining candles, lanterns, and various battery-powered lamps, and using diode lamps instead of load resistors to compensate for interruptions in the daily lighting system will provide greater convenience and economic savings.

It should be said that one of the promising ways to create effective thermoelectric materials is to create nanostructured composites.

In the following years, the theoretical and practical interest in thermoelectric nanostructures has increased, and more promising results have been achieved. However, solving fundamental research results requires complex engineering and high-tech solutions. The enhancement of electrical and thermoelectric characteristics of nanocomposites is related to two physical processes. The first is to achieve a decrease in thermal conductivity while maintaining electron transport, that is, conductivity, and the second, according to the

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electron kinetic theory, is to achieve the optimal value of the concentration of electrons in the absence of strong turbulence in exchange for increasing the density of states near the Fermi level in the nanomaterial. In reality, it is natural for materials with high electrical conductivity to have high thermal conductivity. According to existing theories [1], the use of nanocomposites is considered effective for targeting both processes.

The advantage of nanocomposite thermoelectric materials is that the size of nanoparticles in them is in the order of wavelengths of phonons, which are considered active in heat transfer, so phonons can be scattered in nanoparticles and heat transfer can be drastically reduced.

Fulfillment of this condition helps to optimize the characteristics of thermoelectric materials.

The purpose of the work is to study the relationship between the composite electrical conductivity and the thermoelectric driving force at constant temperature difference to the concentration of conductive nanoparticles (filler) introduced into the mineral matrix with poor conductivity. For this purpose, a sample was prepared by grinding the local tricalcium aluminate mineral to a finely dispersed state and adding nano-sized iron carbonyl Fe2CO5 particles to it in different concentrations. In the preparation of the sample, the matrix and the filler were mixed in different volume fractions, and then they were crushed and mixed for 4-5 hours.

Then, together with forming under high pressure, the connection copper electrode was also formed.

The results of the experiment are shown in Figures 1 and 2 below.

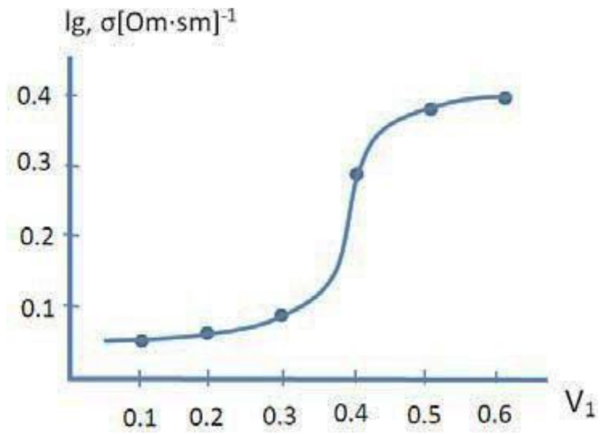

Figure 1. Dependence of sample conductivity on volume fraction of iron carbonyl nanoparticles.

It can be seen from them that the electrical conductivity of the nanocomposite increases very slowly up to the value of 0.4V as the volume fraction of iron carbon nanoparticles increases and increases sharply when it reaches the value of 0.4V. Such a change in permeability can be understood within the framework of flow theory. That is, when the volume fraction reaches the value of 0.4V, the conductivity increases sharply due to the

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continuous connection of conductive particles in the sample volume. When a temperature difference of 200^0C was created at the ends of the samples with copper, and the relationship between the value of the conductive force caused by this temperature difference and the volume fraction of iron carbon nanoparticles was studied, the relationship as shown in Fig. 2 was observed. It can be seen that the change in the value of the driving force also changes in accordance with the increase in conductivity. That is, the concentration of iron carbon nanoparticles reaches its maximum value when the volume fraction is equal to 0.4V. It can be concluded from these that when the concentration of nanoparticles reaches the current limit, the value of electric conductivity reaches a maximum, while the thermal conductivity remains almost unchanged. That is, the structural arrangement of nanoparticles in the composite is not yet ordered, and phonons are mainly scattered in chaotically arranged nanoparticles. With the further increase in filler concentration, the role of the structural arrangement of conductive nanoparticles in heat transfer increases, and the value of electrical conductivity begins to decrease. The obtained connections indicate that the value of electrical conductivity can be optimized by changing the volume fraction of nanoparticles, and with the correct choice of chemical composition, it is possible to increase the absolute value of electrical conductivity.

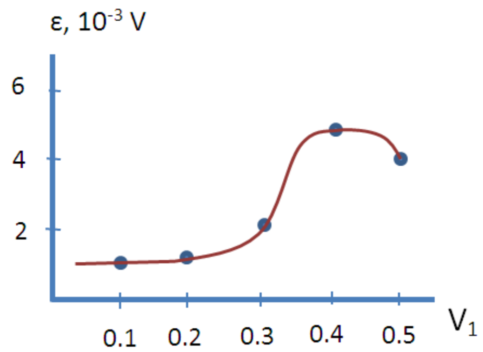

Figure 2. Correlation of the value of electric conduction force formed at the junction of Cu with the sample at $\Delta T=200^0$C to the volume fraction of iron carbon nanoparticles.

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