STUDY OF TENSOELECTRIC PROPERTIES OF "L-28X" GRADE SILK FIBERS

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Abstract. *The main tasks and results of the research are as follows. The tensoelectric properties of undoped and iodine-doped silk fibers of the "L-28X" variety were determined under the influence of uniaxial pressure. The research was carried out in the temperature range of 300-360 K and voltage in the range of 0-100 V. According to the research results, as the pressure increased, it was observed that a higher current passed through silk fibers doped with iodine compared to the undoped sample. All samples prepared as objects of research were subjected to the current passing through Ohm's law. Compared to the undoped sample, it was found that the current passing through the doped sample is several times higher, and the electrical conductivity increases under the influence of uniaxial pressure. It was determined that the doping time depends on the conductivity and the change in the concentration of charge carriers. Entering molecules settle in the lattice defects of the polymer, form a deep layer in the forbidden band and provide conductivity.*

Keywords: *silk fibers, volt-ampere characteristics, electrical conductivity, diffusion, tensoelectric properties.*

Introduction. Currently, microelectronics and electrical engineering have reached their highest stage. This, in turn, makes a great contribution to the development of new problems and the integration of electronic technology, i.e. nanoelectronics. The development of nanoelectronics requires the perfect development of fiber physics. Based on this, one of the ways to solve the current problems of the development of nanostructures in the first half of the 21st century is to study the basics of fiber physics. For the first time in the world, in Uzbekistan, it was found that cotton and silk fibers have semiconducting properties [1-2].

Academic A.T.M. conducted researches over many years in the Laboratory of Physics of Natural Fibers under the leadership of Dr, physical properties are different depending on the varieties. Natural fibers have a nanostructure. During the study of such structures, it was determined that physical processes and phenomena are manifested in them [1-3]. Until now, the physical properties of natural fibers, especially cotton and silk fibers, that is, electrophysical properties and tensoelectric properties, have not been fully investigated. In this paper, we have studied the electrophysical properties and tensoelectric properties of natural fibers. To date, the physical properties of several types of silk fibers (SF) have been studied [4]. However, the tensoelectric properties of "L-28X" silk fibers have not been studied. This article presents some results of studying tensoelectric properties of unalloyed and iodine-alloyed samples of "L-28X" silk fibers under uniaxial pressure. Alloying is an important factor in controlling conductivity in polymers [5].

Experience part. We selected undoped and iodine-doped "L-28X" SF for the experiment. First, the cocoon was extracted using a fiber wrapping device. The number of fibers in the sample is 5,250. The extracted fiber was dried and cut into 0.5 cm. The cut sample was washed in distilled water at 80^0C for 20 min and dried at room temperature (T≈300K). The samples were kept at room temperature (T≈300K) for 20 min in a bath containing a 5% solution of iodine in alcohol, and then removed from the bath and alloyed in a 75^0C thermostat for 7 hours. The atoms forming a bond in the composition of the fiber increase its electrical conductivity several tens of times. As a result of changing the molecular structure of silk fibers alloyed with chemical compounds, their electronic state can be changed. This, in turn, causes changes in the electrophysical properties of silk fibers.

We needed liquid glass, graphite powder and copper wire to make the sample. First, electroconductive glue was prepared by adding graphite powder to the liquid glass and mixing, and ohmic contact was made using a copper wire. Resistance of ohmic contacts is 100-200 Ω•cm, sample length is 6 mm. The electrophysical characteristics of the samples, that is, the small values of the current, were measured using an electrometer Sh-300 (in nanoamperes). Experiments were conducted in the temperature range of 298–360 K and voltage range of 1–100 V.

Results and discussions.

An iodine-alloyed sample was used to determine the effect of "L-28X" silk fibers on uniaxial pressure. In this case, without changing the voltage from 0 to 100 V, we can observe that the current increases as the pressure increases (Fig. 1).

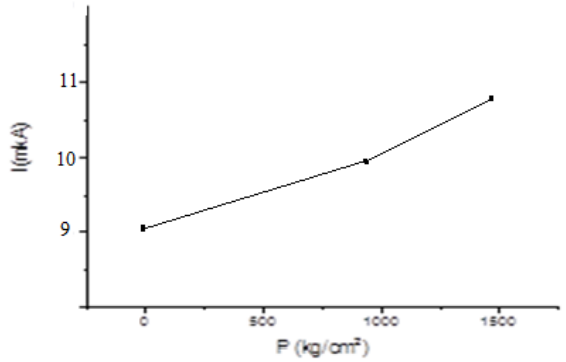

Figure 1. Changes in the current passing through the sample under the influence of uniaxial pressure of "L-28X" grade silk fibers ligated with iodine

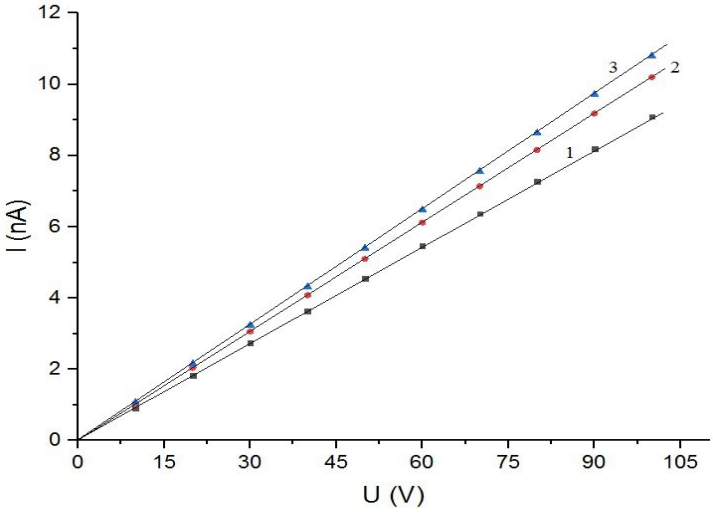

Figure 2. Volt-ampere characteristics of "L-28X" type silk fibers ligated with iodine under the influence of uniaxial pressure. status under the influence.

In this case, the current passing through the sample without the effect of uniaxial compressive force (P=0kg/cm^2) is I_{max}≤9.1 nA, and the current passing through the sample when the compressive force is P=1000kg/cm^2 We can observe that I_{max}≤10.2 nA and the current passing through it increases to I_{max}≤10.8 nA when the pressure effect is P=1500kg/cm^2 (Fig. 2).

Temperature dependence of electrical conductivity under uniaxial pressure.

Iodine-doped "L-28X" silk fibers were subjected to uniaxial pressure. Voltage U=60V. It was found that when the sample is pressured P=1500kg/cm^2 and the temperature is increased from 30^{0}C to 55^{0}C, the current increases from 1.46 nA to 2.67 nA. Temperature dependence of electrical conductivity of "L-28X" silk fibers was investigated. It was found that the current passing through the sample increases according to the exponential law with increasing temperature.

Thermal ionization energy, respectively, is equal to E_{t1}=1eV.

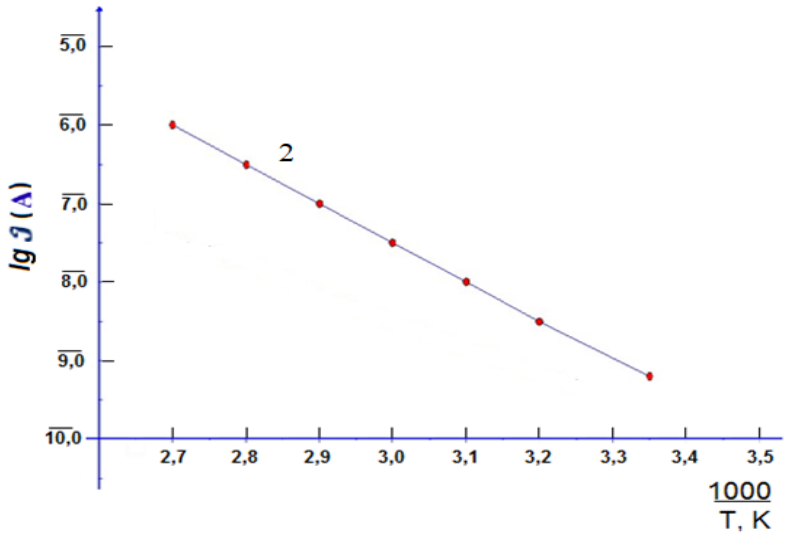

Figure 3. Temperature dependence of electrical conductivity without uniaxial pressure P=0 kg/cm^2, activation energy E_t=1eV, U=60V.

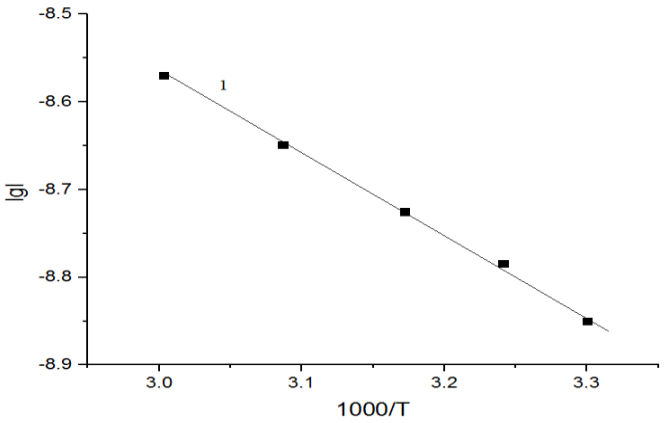

Figure 4. Temperature dependence of electrical conductivity under uniaxial pressure. Uniaxial pressure P_1=1500 kg/cm^2, activation energy E_{t1}=0.18eV, U=60V.

It was determined that the temperature dependence of electrical conductivity is E=0.18eV when the pressure of P=1500kg/cm^2 is applied to the sample ligated with iodine.

So, we found out that when the silk fibers of "L-28X" grade are given constant voltage U=60V, the current strength increases as the pressure increases. It was found that the temperature dependence of the electrical conductivity is that the activation energy E_t=1eV when the pressure P_1=0 kg/cm^2 is applied to the sample, and the activation energy E_t=0.18eV when the pressure

P=1500 kg/cm^2 is applied. As the uniaxial pressure on silk fibers increases, the activation energy decreases. This is due to the reduction of the forbidden zone of silk fibers.

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