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STUDY OF ELECTRIC AND PHOTO-ELECTRIC PROPERTIES OF COTTON FIBERS OF THE GRADE C-6524 ALLOYED BY $KMnO_4$

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ABSTRACT

For the first time diffusion $KMnO_4$ in cotton fibers (CF) grades C-6524 is carried out and is revealed their semiconductor properties. Laws of temperature dependence of electrical conductivity and energy activation of deep level formed at entering $KMnO_4$ in CF grades C-6524 are defined. Kinetics of photoconductivity are studied and the long-term relaxation of photoconductivity after illumination by light with $h\nu = 5{,}0$ eV is found out.

KEYWORDS: Cotton fibers, diffusion, alloying, volt-ampere characteristics, electrical conductivity, photoconductivity.

INTRODUCTION

Researches of physical properties of natural fibers have been intensively conducting recently.[1-8] The reason for that is detection of semiconductor properties of cotton, silk, cobwebby fibers (CF, SF, CWF), and cattail fibers. On the basis of cotton and silk fibers are

created elements of the electronic equipment photodetectors, on the basis of CF and SF alloyed by iodine electronic hydrometers are created.

It was defined that physical properties of CF, generally is defined by a surface layer - a cuticle. In different grades of CF the cuticle has different physical properties. It is revealed that at alloying of CF electrical conductivity increases by several orders of magnitude. Therefore, expansion of a round of researches allows to reveal the general regularities of electro physical properties of fibers and mechanisms of the electronic processes happening in fibers, and also to develop discrete elements of the electronic equipment.

Physical properties of different grades of CF are investigated in.[1,3,7,8] However, electro physical properties of CF of a grade of C-6524 haven't been investigated.

Some results of electro physical properties of CF of a grade C-6524 alloyed by $KMnO_4$ has been given in this work.

EXPERIMENTAL RESULTS AND DISCUSSION

Mature CF served as objects of a research. Samples were made in the form of a small bunch of the fibers laid parallel to each other in number of 5000-10000 pieces of the impregnated 1,5% with water $KMnO_4$ solution. Alloying of CF with $KMnO_4$ were made at a temperature of 80^0 C within 0,5-5 hours. Cooling of samples was carried out at the room temperature.

Ohmik contacts were created on the basis of superposition of graphite powder with liquid glass. Specific resistance of ohmik contacts is 100-200 Ohms. sample length is 5 mm.

Experiments show that at increase of time of diffusion from 1 to 7 hours the current proceeding through a sample at V=100 volts increases from 32 nA to 520 nA, respectively. It apparently is connected with interaction of $KMnO_4$ with a surface layer cuticle thickness of which is $\approx 1mkm$ equal 15 microns at the nominal diameter of CF. Let's note that the current getting through a sample in control samples at V=100 volts makes 3.5 on.

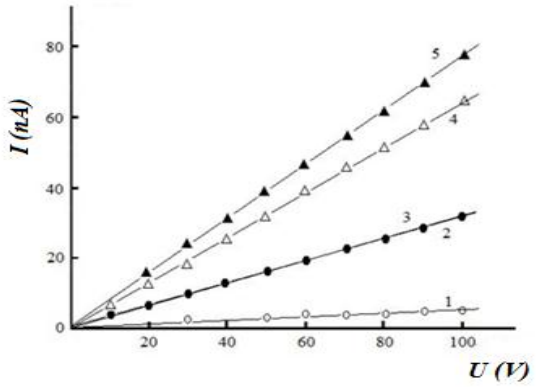

Fig. 1: The volt-ampere characteristic of CF of a grade of C-6524 which are not alloyed (initial) 1 and alloyed with $KMnO_4$ at different times of diffusion of t, hour: 2-1,0; 3-2,0; 4-3,0; 5-4,0.

Volt-ampere characteristics (VACh) have the linear character in the direct and opposite direction. In the figure 1 typical VACh initial not alloyed (a straight line 1) and the alloyed $KMnO_4$ are shown at different times of diffusion (straight lines 2-5). From the drawing it is visible that at increase of time of diffusion the current proceeding through a sample increases.

The experiments on influence of light on VACh were made. An OBN-60 bactericidal uviole lamp with a radiation maximum at 254 nanometers (hν 5.0 eV) was used as a light source. In fig. 2 VACh CF alloyed with $KMnO_4$ in the dark (1) and when lighting by light with hν=5,0 eV (2) is shown. From the drawing it is visible that VACh is linear in both cases. Increase of current at lit by light hν=5,0 eV is connected by optical transition of electrons from Valente zone in a zone of conductivity and formation of electron-hole couples.

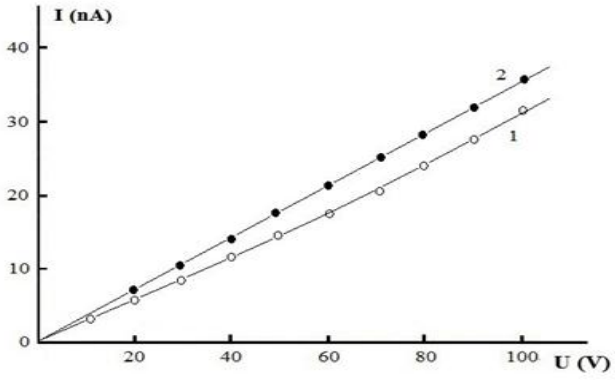

Fig. 2: VACh CF of a grade C-6524 alloyed at t=80^{0}C within an hour. A straight line- 1 in darkness, at lit by light with hν=5,0 eV.

Studying of kinetics of photoconductivity (PC) at lit by own light showed the exponential growth of photoconductivity from time constant τ_r =150 s. After light switching the long term relaxation is observed off photocurrent decreases slower than increase (fig. 3). It is apparently connected with sticking of electrons on deep levels of $KMnO_4$ put into CF.

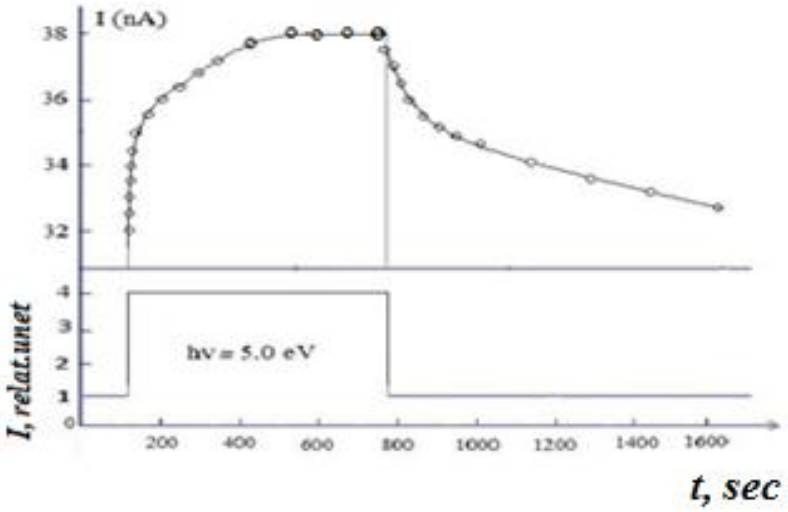

Fig. 3: FC kinetics by lighting switch on and off.

With hv= 5,0 eV>E_g (Eg- band gap CF, Eg=3,2 eV*)*

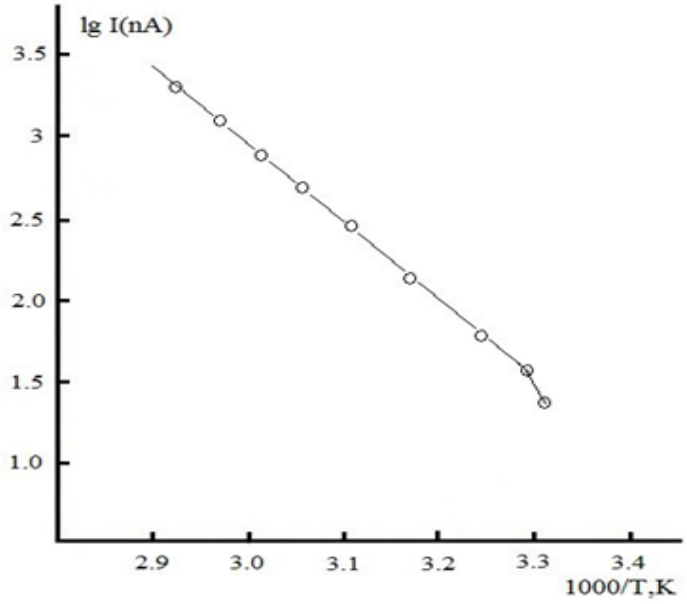

Fig. 4: Temperature dependence of electric current passing through a sample from temperature.

In fig. 4 the temperature dependence of current proceeding through CF, alloyed $KMnO_4$ is shown. It is revealed that the conductivity increases at temperature increase under the exponential law. Energy of activation of this process is equal $\approx 0{,}91$ eV.

It indicates that at putting $KMnO_4$ into C-6524 grade CF in the band gap level with energy activation of E_t=0,91 eV is formed.

CONCLUSION

Diffusion $KMnO_4$ in cotton fibers of grade C-6524 is carried out. Ohmik contacts to cotton fibers on the basis of superposition of a graphite powder with liquid glass are created.

Work has been performed in the framework of the Memorandum of mutually beneficial cooperation between Hudzhand State University of the Republic of Tajikistan and National University of Uzbekistan named after M. Ulugbek of the Republic of Uzbekistan and also the grant of OT-F2-29 Agency of science and technology of RUz.

Volt-ampere characteristics are investigated and it is established, that they have linear character in a direct and return direction.

It is revealed, that at increase time of diffusion electrical conductivity increases.

Temperature dependence of electrical conductivity of cotton fibers of grade C-6524 alloyed $KMnO_4$ is studied and it is established, that electrical conductivity at high temperature increases on exponential law with energy activation equal 0,91 eV.

The photo effect is found out at illumination of the sample by light with hν =5,0 eV and a long-term relaxation of photoconductivity caused by sticking electrons on deep levels.

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