Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2018, 5(2):14-17**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Study of Electrophysical Properties of Cotton Fibers Doped Iodine

A.T. Mamadalimov, N.K. Khakimova, R.U. Khakimova

National University of Uzbekistan named after M.Ulugbek

Abstract The photoconductivity (PC) of the cotton fibers (CF) grade "F175" doped by iodine is investigation. The samples discovered a long-term relaxation of the PC after irradiation (hv=5 eV of the iodine doped CF and have been found infrared quenching at combined illumination.

Keywords electrophysical, cotton fibers, doped iodine

Introduction

In [1] suggested that the temperature dependence of the electrical conductivity of the cotton fibers (CF) is associated with the appearance of semiconductor properties in them. In [2] the photoelectric properties CF doped with iodine studied and determined that the width of the band gap CF is E_g = 3.2 eV.

From the results of [2,3] one can conclude that the intrinsic viscosity can be considered as a good semiconductor material by heat, ionizing radiations, the introduction of alloying elements, it changes the electrical conductivity and photoconductivity. Our studies have shown that the physical properties depend on the variety and maturity of the intrinsic viscosity of CF.

Despite the fact that the physical properties of CF of currently poorly understood at their basic thermistors [4], photo resistors [5], diodes and photodiodes [6], the electronic hydrometer [7] and the field effect transistors [8]. Extensive range of studies of nanostructured semiconductor CF reveals new physical laws and new items of electronic equipment.

In this paper we present the results for CF grade F175 that previously little-studied, doped with iodine.

In the measurements the mature CF were used. The samples were prepared in the form of a bundle of fibers laid parallel to each other in an amount of 5000 – 10 000 units alcohol impregnated 10 % iodine solution, and treated with t = 20 – 60 ^{0}C for 30 to 600 minutes. The sample length was 4-8 mm. Ohmic contacts were created on the basis of a liquid suspension of graphite crystal. Current-voltage characteristics of the samples were made linear. Preliminary measurements showed that after doping CF with iodine the samples had n- type conductivity.

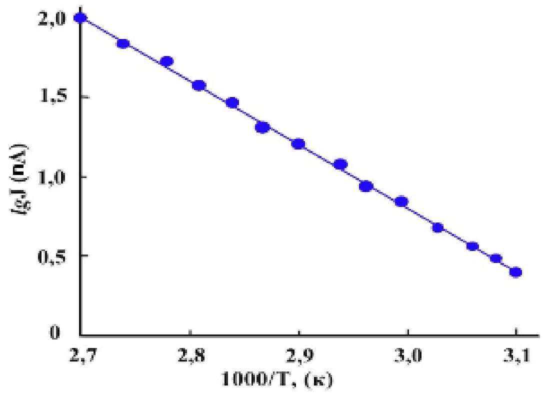

Figure 1: Temperature dependence an electric current through the sample CF grade "F175" doped with iodine

Figure 1 shows the results of measurement of the temperature dependence of the electric current through the sample. One can be seen that the electric current through the sample while raising the temperature increases exponentially. Thermal ionization energy equal to Et = 0.8 eV.

Figure 2 shows the spectrum of photoconductivity without (1) and illumination with UV (hν = 5 eV) light (2).

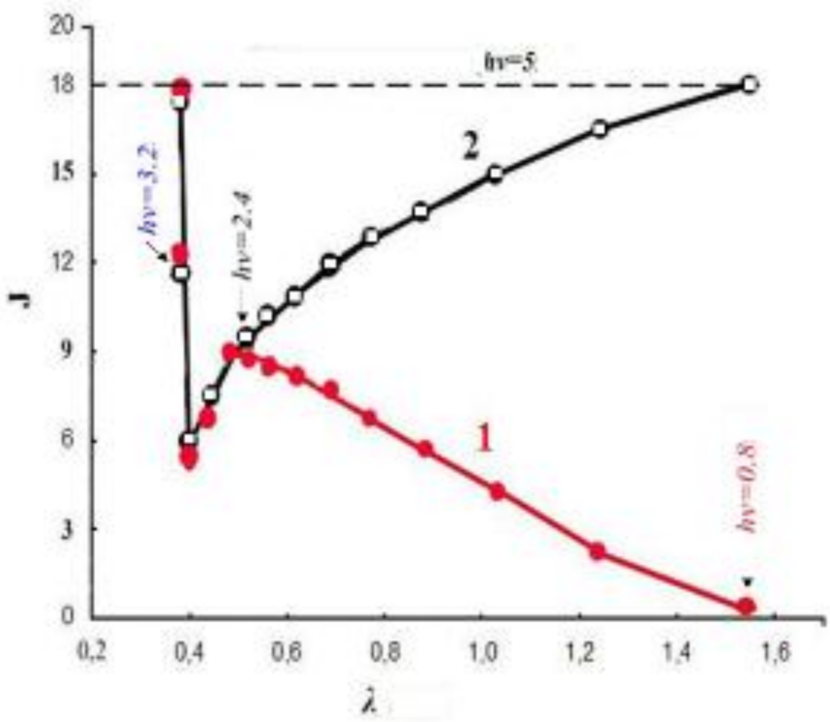

Figure 2: Photoconductivity spectra of CF doped with iodine without (1) and illuminated with UV light (2). Units of J is nA, λ is micron, hν is eV.

Measurements have shown that even after long exposure (3 hours) of the sample in the dark spectrum of photoconductivity began with hν = 0.8 eV. By increasing the energy quanta observed maximum at hν = 2.4 eV. At constant illumination, created by the UV radiation, since hν = 0.8 eV there was a decrease of photoconductivity (PC), i.e. IR quenching PC observed. In this course the PC spectrum, stating with hν = 2.4 eV, similar to PC spectrum obtained without own backlight. The absolute values of the photocurrent caused by IR quenching of PC increases with its own illumination intensity.

Measurements of the kinetics PC when illuminated the sample with UV light showed that the photocurrent rise is exponential.

After turning off the UV light was observed long-term relaxation of the PC, the duration of which reaches up to 6 days. If after turning off the UV-light turn on the light with hν = 0.8 – 1.3 eV than PC flash is observed. However, the amplitude of the flares is small, the decline of PC to dark values occurs relatively quickly. Measurements of IR kinetics of PC quenching at a constant own illumination showed that when the light is turned on with hν = 1.0 eV increasing in PC up to constant value in 20 sec is observed and then seen decreasing it below the background photocurrent. Next, after turning off the light with hν = 1.0 eV a slight sharp decreasing of PC and exponentially increasing of photocurrent (t=50 min.) to the background current is observed. Lux-ampere characteristics (LAC) under light illumination with hν> 0.8 eV is linear.

In the framework of the classical band model of semiconductors, the above features of PC CF can be explained as follows. It has previously been shown [9] that LAC depends on the degree of filling of the deep level. Experiments show that the iodine doping increases the photosensitivity of CF. This is only possible if the iodine produces deep levels in the band gap of CF. Presenting that iodine creates a deep donor levels in the upper half of the band gap. It is possible to say that an increase the intensity of light increases the degree of filling of deep level due to the transition of electrons from V-zone at the level Et through C-zone. Starting PC spectrum (hν = 0.8 eV), presumably due to the fact that in the CF iodine creates deep ionization energy levels with Ec = 0.8 eV (see Fig.3).If one take into account that CF after iodine doping is n-type by conduction, it can be assumed that the level is in the upper half of the band gap with Et = Ec – 0.8 eV.

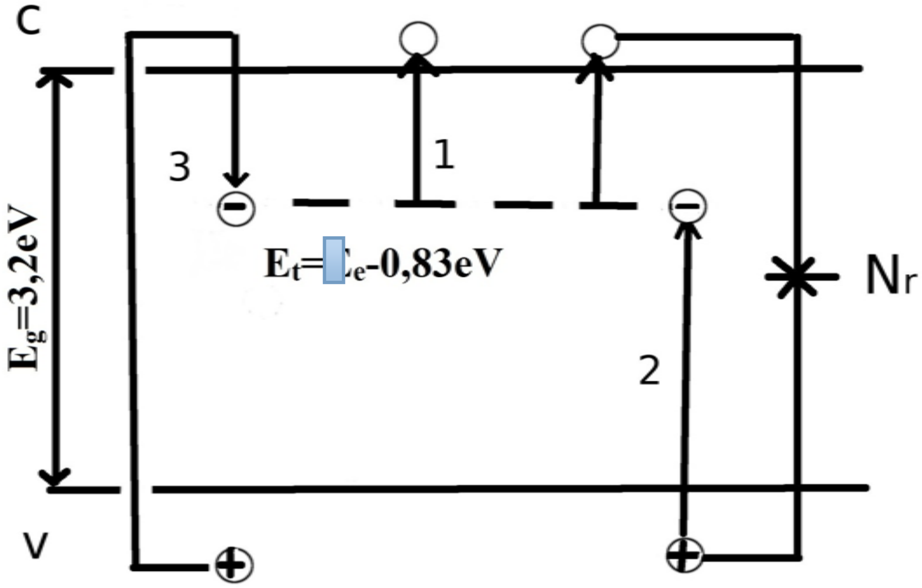

Figure 3: Zone diagram of CF grade "F175" doped with iodine

Analysis of the spectra and kinetics of PC show that the level with Et = Ec – 0.8 eV has a donor character. Monotonous growth PC in 0.8<hv<2.4 eV due to the transition of electrons from the level of Et in the C-zone. Reducing PC, beginning with hv>2.4 eV, due to the transition of electrons from the v- band to level Et, followed by recombination of free electrons and levels in the V-zone through uncontrolled recombination centers. Background photocurrent formation due to the fact that when covering CF by UV light generated electron-hole pairs. The electrons that have fallen to the C-zone trapped in the Et level. Therefore the background current is determined by the holes in the V-zone. IR quenching of the phase transition at constant self-illumination UV rays due to electron transitions from Et levels in C-band, followed by recombination of holes in the V-zone through recombination centers of Nr.

References

[1]. Shermatov M., Mamadalimov A.T., Usmanov T.A., Shermatov Sh. M. On the electric conductivity of cotton fibers. // Reports of Uzbek Academy of Sciences, 1995, No. 4, p.21-22

[2]. Mamadalimov A.T., Khakimova N.K., Shermatov M. Some problems of modification of the physical propreties of cotton fibres. // Book of abstracts of International Simposium "Polimer science on the threshold of XXI century", Tashkent, 1999, 20-22 October, p.109-110

[3]. Mamadalimov A.T., Khabibullaev P.K., Shermatov M. Some problems of modification of the physical propreties of cotton fibres.// Uzbke Journal of Physics, 1999, v.1, No. 6, p.465-479.

[4]. Shermatov M., Mamadalimov A.T., Usmanov T.A., ShermatovSh.M.Thermistor. First patent No. 2441. (51) 5H01C 7/04, 16.09.1994, No. 926 RegisterNo. ИДР 9400557.1, 27.06.1994. 27.06.94 Buletten No. 1.30.03.953 C. 3.

[5]. Shermatov M., Mamadalimov A.T., Tulanov V.T., Turaev B.E. Photoresistor. IDR 2000.0088GFMKI 6N 0IL 31/06 Pleniminary patent.

[6]. Zakirov A.S., Yuldashev Sh.U., Cho H.D., Le J.C., Kang T.W. and Mamadalimov A.T. Organic photodiodes on the base of cotton fibers/polymer composite. Journal of Applied Physics 110, 114522 (2011). 114522-1 – 114522-6.

[7]. Mamadalimov A.T., Mukhamedov G.I., Khamdamov J.J., Adkhamov A.N., Umarov Sh. Kh., Akhmetdjanov G., Akhmetdjanov D.G., Zakirov S.A., Mukhtarova F.A., Khakimova N.K. Humidity meteron the base of cotton fibers. Reports of Uzbek Academy of Sciences, No. 1, 2015,p.15-18

[8]. Giorgio Mattana, Piero Cosseddu, Beatrice Fraboni, George G. Malliaras, Juan P. Hinestroza, Annalisa Bonfiglio. Organic electronics on natural cotton fibers. Organic electronics 12 (2011) 2033-2039.

[9]. Lebedev A.A., Mamadalimov A.T. Dependence of light in impurity band spectra at low temperatures on the degree of samples compensation. FTP, 1976, v.9, No. 8, p.1609-1611.