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ELECTRONIC PROPERTIES OF SEMICONDUCTING POLYMER PREPARED FROM TEFLON

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Abstract The semiconducting structure with conjugated bonds were prepared from polytetrafluoroethylene (teflon) by treatment with THF solution of alkali metal naphthalides. The IR and EPR spectra as well as the electrical and thermoelectrical properties of these structures were investigated.
The electrical conductivity of these structures proved strong dependence on atmospheric moisture.

INTRODUCTION

The unusual properties of polyacetylene as well as its possibilities of application[1] have caused a great interest in searching for new materials with similar properties. Recently Yoshino et al[2] reported some properties of structures with conjugated bonds obtained by chemical modification of polytetrafluoroethylene (PTFE, teflon). The possibility of chemical modification of teflon as well as properties of the obtained structures seem very interesting for us, so we have modified PTFE according to Yoshino et al[2] and carried out IR, EPR, electrical and thermoelectrical measurements on the obtained structures.

EXPERIMENTAL

The polymers with conjugated bonds were prepared by elimination reaction of fluorine from

teflon, according to Yoshino et al[2], by treatment with a tetrahydrofuran (THF) solution of alkali metal naphthalides. By this reaction the polymer structure change took place only in surface layers with thicknesses dependent on reaction time. The obtained black films were several times washed with THF and dried in vacuum. Some of films were then boiled in distilled water, and dried in vaauum.

Spectroscopic measurements IR, EPR have been taken on the materials obtained as a result of scraping the modified surfaces of films.

The measurements of electrical conductivity and thermoelectric power were taken after the silver electrodes on one surface of samples were vacuum deposited.

RESULTS AND DISCUSSION

The characteristic feature of the structures obtained by chemical modification of teflon is their black colouring, moveover, these structures were insoluble in organic solvents. IR spectra of this structures show the following absorption bonds: 1020 - 1080cm^{-1}, 1613 cm^{-1}, 2490 - 2857 cm^{-1} which are characteristic for conjugated bonds[3]. The alkali fluoride content in modified PTFE layers has been estimated as about 40% from density measurements before and after water extraction. Both the EPR spectral lines width and the intensity prove that paramagnetic centres have a localized nature.

There is observed a strong effect of air on electronic properties of modified PTFE table 1 . This effect is associated with the presence of moisture in air. Due to this both electrical conductivity and thermoelectric effect in air are to a great extent

TABLE I Electronic properties of modified PTFE

THICKNES OF MODIFIED LAYER			5 μm
ELECTRICAL CONDUCTIVITY AT ROOM TEMPERATURE	SURFACE	IN AIR	$2,1 \cdot 10^{-10}\ \Omega^{-1}$
		IN VACUUM	$3,2 \cdot 10^{-15}\ \Omega^{-1}$
	BULK	IN AIR	$4,3 \cdot 10^{-7}\ \Omega^{-1}\text{cm}^{-1}$
		IN VACUUM	$6,3 \cdot 10^{-12}\ \Omega^{-1}\text{cm}^{-1}$
ACTIVATION ENERGY OF ELECTRICAL CONDUCTIVITY AROUND ROOM TEMPERATURE IN VACUUM			0,3 eV
SIGN OF THERMOELECTRIC POWER IN VACUUM			+
EPR IN AIR	VALUE OF G		2,0053
	NUMBER OF UNPAIRED SPINS/G		$1,5 \cdot 10^{18}$
	LINEWIDTH		9,75

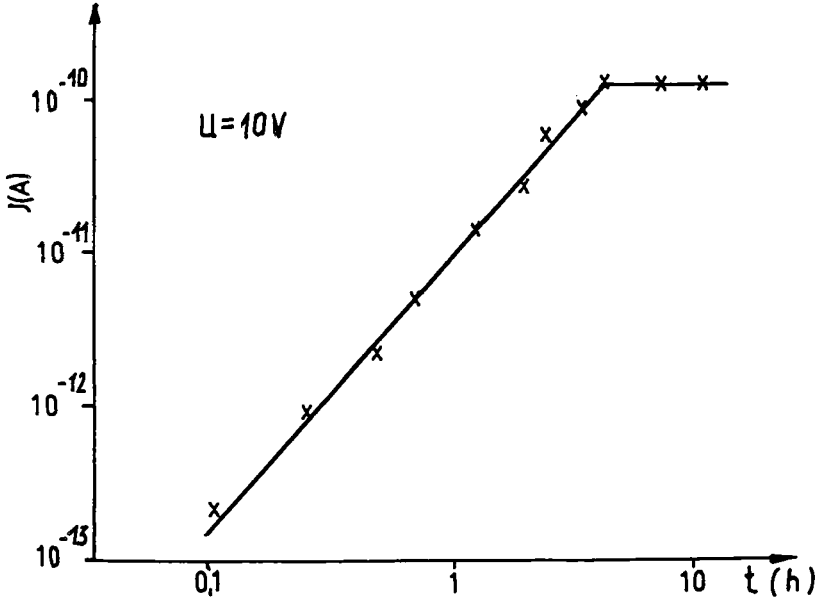

FIGURE 1. Time dependence of electrical current of modified PTFE after inlet of air with 40% of relative numidity.

determined by moisture adsorption and desorption kinetics. Fig.1. Electrical, thermoelectrical and EPR measurements indicate that there is a hole hopping transport in these structures in the absence of moisture, whereas in the presence of moisture electrical properties are determined by ionic conductivity.

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