NANOSTRUCTURED DISPERSED FILMS IN BIOMEDICINE FOR HUMAN HEALTH

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Abstract. The nanostructures on basis of hard-fuse metals and their oxides were proposed. The electrical properties of films were investigated in longitudinal and transversal direction. In the transversal direction was observed the second-order phase transition: films pass from conducting state to non-conducting state at temperature increasing. This is given by dimensional effects in this material. In these nanocompositional structures was observed the switch effect. It can be attributed to formation of energetically bonded of more large nanoclusters. The electric sustainability of the nanocompositional films is not less than $(5.0\text{-}7.0)\times10^3$ A/cm^2. The switch effect has high charge sensibility in these films. We used this fact for sensitize the nanocompositional films of medical device МАГ-30-3 produced by Russian industry. The possibility of use of charged films in human biomedicine was shown.

In connection with constant process of dramatic complication of functions performed by electronic equipment the number of microelements in the integrated electronics increases dramatically. The necessity appears to create and use functional means, which would provide an adequate reflection of the needed functions with the help of the physical phenomena in the substance.

From this point of view unordered condensed systems like metal-dielectric (Me-Di) connected by the dimensional effects are of particular interest. Depending on the used material and correlation of concentrations dielectric (N_d) and conducting (N_{me}) parts the nominal of the thin-film resistance, mechanism of resistance, the value and sing of resistance temperature coefficient (RTC) changes as well as clear dependence of films conductivity on external influence (temperature, pressure, bending, humidity, etc.) is found.

The proposed material is a dielectric matrix with evenly introduced throughout its volume conductive granules. Such films with the thickness of 40-60 nm are produced with planar technology with the use of grouping methods of processing on sital and glass basis using refractory metals (Cr, V, Ti, etc.) and their oxides. Low-energy processes of producing and the selected

conditions of forming of fine-dispersed structure Me-Di justify high time-stability of the electrophysical parameters and their controllability [1-3].

For thin films with $N_d > N_{me}$ the longitudinal resistance is within 10^4 – 10^8 Ohm/□, RTC is negative 5×10^{-3} - 5×10^{-1} grad^{-1} (Fig 1).

For the same layers the resistance in transversal direction is no more than 3 Ohm, RTC is positive (Fig 2), i.e. with the increase in temperature the layer resistance is higher. Depending on technological conditions of the material production the increase in temperature may produce the critical temperature under which the resistance of resistive film goes up to infinity. After lowering of the temperature and "memory" of the dielectric part of the material removal, VAC are completely identical to the initial ones. Thus, phase transition of the second type is found with the transition of the conductive state of the resistive layer to the nonresistive one and vice verse.

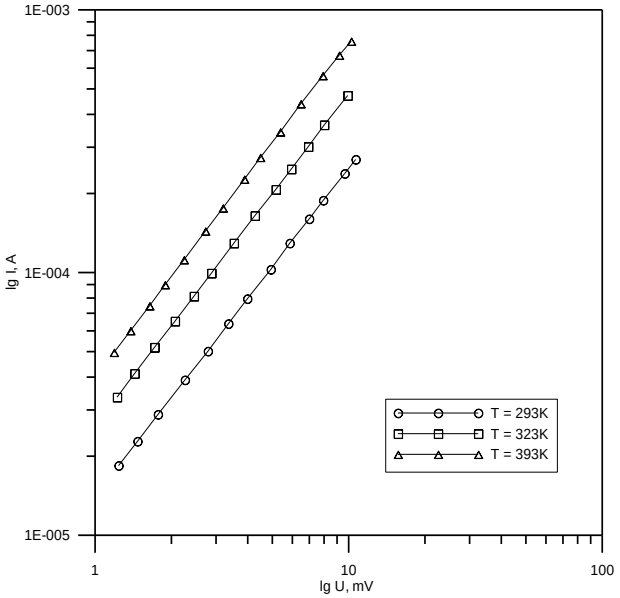

Fig 1. Resistive layer temperature dependencies on I-V ch. in the longitudinal direction

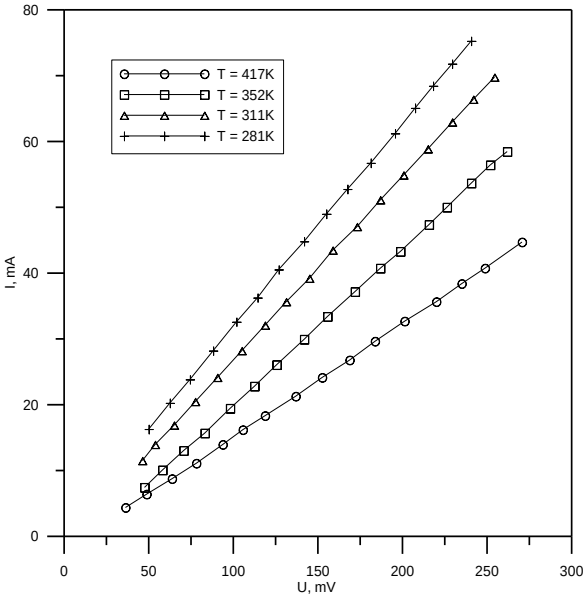

Fig 2. Resistive layer temperature dependencies on I-V ch. in the transversal direction

In this case dimensional effects of fine-dispersed structure are clearly seen: with the square of the upper contact more than 1.5 mm^2, the phase transition is not observed. Lowering of the square of the contact to less than 1.0 mm^2 brings phase transition appearing and to more exact setting of the critical temperature.

For the materials with $N_d < N_{me}$ longitudinal resistance of layers is within $(0.5\text{-}5.0)\times10^3$ Ohm/□ and RTC is no more than $(3.0\text{-}5.0)\times10^{-5}$ grad^{-1}. The parameters of tensosensitive elements from such layers do not depend on temperature and their sensitivity is 4-6 times higher than the sensitivity of silicon tensosensors.

In studying of VAC in transversal direction the fine-dispersed structures may show "switch-effect" conductivity (Fig.3) with their value of lowering effective resistance but with the linearity at

every level of VAC preserved. The electric sustainability of the resistive films at maximum level, which is not less than (5.0-7.0)×10^3 A/cm^2 is assessed

Thus, the set caused state of the material is justified, first of all, by the functional characteristics of nano-particles evenly spread in highly efficient dielectric matrix. The caused state can be clearly seen in photovoltaic effect. Using fine-dispersed oxides as wide-zone window of *n*-type for *p*-$CuInSe_2$ absorber brings to the short current increase as regard of the photo-element structure n-CdS – p – $CuInSe_2$ [4].

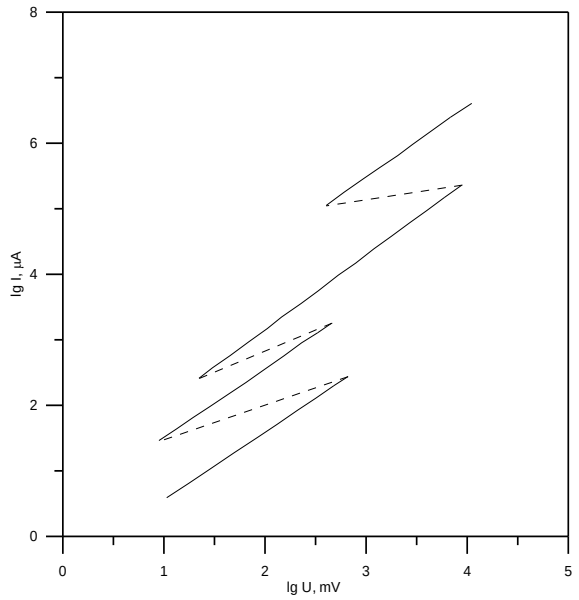

Fig 3. "Switch-effect" conduction at I-V ch. measurement

In the collection of articles [5] dedicated to the use of nano-structural materials in biomedicine I. Uvarova informs about the studies on the use of the effects of ultrafine compositions of ferromagnetic nanoparticles based on á -Fe stabilized by oxide and carbide iron. They are having potential for use at medical treatment of festering and infective wounds, pathology of thyroid gland in oncology for prolonged delivery of hormones into living body. Nanosized magnetic materials based on α-Fe with the particles sizes of 1-10 nm are the carriers of medicines to their intended destinations, they decrease the load on living organism, and increase the selectivity of effect on the pathologic tissues. The articles [5] show the possibility of nano-demensional particles use to delay the cancerous growth in the cells coagulating with nanosized ferromagnetic.

In non-traditional practical treatment fullerene pyramids produced from natural mineral schungite for treating allergic, epidermis, respiratory, gynecology, muscular and joint diseases. In the opinion of Dr. Med K.G. Umansckii [6], adenovirus, appearing in the human body effected by the technological progress, loses its negative characteristic ass regard of living cell when subjected to fullerene resonance, thus the state of health of a person is improved. By the way, the above mentioned work [5] informs that to improve the performance of the mitral valve on the basis of Ti – steel fullerene passivation is applied to.

The Russian Federation has launched the production of modern electric devices [7] for both medical institutions and home use. The human body has substances which interact in complex way with the magnetic field changing the condition of the diseased cells, which results in medical effect under such diseases as acute and exacerbated arthritis, trifacial neuralgia, thrombosis and vascular thrombophlebitis of upper and lower limbs, arm knobs, burns, wounds, etc.

MAG-30-3 portable low-frequency magneto-therapy apparatus is effectively used in treating the above diseases. Magnetic induction amplitude value is 30 mT, voltage 220V, frequency 50 Hz, power no more than 30 W, safety class IIB, dimensions 118x80x47mm, weight no me than 0.6 kg (approved by the Committee for New Medical Equipment of Health Ministry of URSS, protocol N5 on 25.06.1986).

Taking into account the fact that both functional characteristics and caused states justified by the functionality of the nano-conductive particles dispersed in dielectric are set in the material we offer, we have functionally charged the surface of the fine-dispersed thin films with the MAG-30-3 apparatus. After this the volunteers have been subjected to the following experiments:

1. With foot numbness, between the toes and instep. Two times application of the charged plate to the place of numbness for 3 minutes with the interval of 24 hours relieved the numbness (tumor). The volunteer resumed jogging for 3-5 km.
2. With hand knob. Two times application of the charged plate for 3 minutes dissolved the knob completely.
3. With ear "blocking", poor hearing as compared with another ear. The plate was applied to the affected ear 4 times for 3 minutes within 48 hours. Ear discomfort was completely relieved.
4. With pain in shoulder joint. Single application of the plate relieved the pain completely.
5. With rheumatic pain in knees, inability to move without crutches. The fifth day abandoned the crutches.

Thereby the attraction of the professionals to this work for estimation of functionality of nanostructured compositions by existing physiotherapeutic devices, will allow the using proposed thin films on basis of the tight-melting metals and their oxides in operative human biomedicine.

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