

## **ADSORPTION - RESISTIVE PROPERTIES OF COPPER PHTHALOCYANINE NANOAGGREGATES IN POLYMER MATRIX**

G.G. FEDORUK, A.V. MISEVICH\*, A.E. POCHTENNY\*, D.I. SAGAIDAK  
Institute of Applied Physics Problems, Belarusian State University, 220064 Minsk, Belarus  
\*Belarusian State Technological University, 220630 Minsk, Belarus

Electrical, optical and sensory properties of copperphthalocyanine nanoaggregates in thin film of polystyrene and plasma-deposited polymer are investigated.

Metalophthalocyanines are promising materials for solar cells, molecular electronics and chemical sensors [1,2]. Phthalocyanine application as gas sensor is based on adsorption-resistive effect consisting of electrical conductivity change in the result of selective molecule adsorption from gas environment. In this case both molecular properties causing adsorption and intermolecular interactions ensuring electrical conductivity are important. Phthalocyanine-polymer composites are of interest for studies of sensory phthalocyanine properties and optimization of the adsorption-resistive characteristics. Inert polymer matrix in these structures separates nanoaggregates of phthalocyanine and allows to increase their effective adsorption surface. It is possible to improve parameters of chemical sensors using these structures. On the other hand, there is the opportunity to distinguish the processes of adsorption and electrical conductivity in the composites.

In the present work electrical, optical and sensory properties of copper phthalocyanine (CuPc) - polymer composites are investigated. The composite films of 50-300 nm thickness were prepared by plasma-activated or laser vacuum deposition. In the first case CuPc aggregates were codeposited during polymer synthesis by plasma technique. Benzene was used as the monomer for plasma polymerization. The capacitive RF (13.56 MHz) discharge was formed between two electrodes with a diameter of 100 mm and distance of 40 mm between them at pressure of about 50 Pa. The CuPc monomer was carried to discharge zone by thermal evaporation. The RF power was no more than 150 W. Concentration of CuPc (5-30 %) in the composite was varied by deposition speed ratio of polymer and CuPc. In the second case the films were prepared by vacuum laser

coevaporation of CuPc powder mixture and polystyrene. LGN-703 laser (wavelength of 10.6  $\mu\text{m}$  and power of 40 W) was used for the evaporation. The films were deposited on glass substrates for optical studies and on ceramic substrates with a pair of interdigital electrodes for measurement of electrical and gas-sensory properties.

dc conductivity temperature dependencies of the fabricated composites in air and vacuum at various concentration of adsorbed oxygen have shown that hopping conductivity mechanism is kept as well as in pure CuPc [3].

dc conduction sensitivity of the composites to  $\text{NO}_2$  was measured in dynamic regime at  $\text{NO}_2$  concentration of 2 ppm in air. The measurements are shown that the composite sensitivity can be both greater or lower than that one of pure CuPc. This depends on the CuPc content in the composite and on the RF power in the case of plasma synthesis.

We have concluded using visible absorption spectra that CuPc is dispersed in two types of the composites obtained as crystalline structures of the polymorphic  $\alpha$ -form at high CuPc concentration. This structure is kept in the laser-deposited composites at low CuPc concentration. Part of CuPc noncrystalline nanoaggregates in the plasma-deposited composites depends on the RF power.

Thus, process of the formation, CuPc nanoaggregate structure and size have the remarkable effect upon sensory characteristics of the manufactured composites. However, hopping conductivity mechanism as a typical feature of low-dimensional systems remains invariable.

## References

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